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HOUSE OF LORDS

SESSION 1994-95
4th REPORT

SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

ACADEMIC RESEARCH CAREERS FOR GRADUATE SCIENTISTS

REPORT

Ordered to be printed 19th July 1995

LONDON: HMSO
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HL Paper 60

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(Q) refers to a Question in oral evidence
(p) refers to a page in HL Paper 60-I of this Session

FOURTH REPORT

19 July 1995

By the Select Committee appointed to consider Science and Technology.

ORDERED TO REPORT

ACADEMIC RESEARCH CAREERS FOR GRADUATE SCIENTISTS

CHAPTER 1 PREAMBLE

1.1 Since the end of World War Two, there has been an enormous expansion in the number of universities in the United Kingdom, in the number of students from both home and abroad attending them and in the number of people who are employed in academic posts at universities and university institutes and facilities. This expansion has not been steady, but has been regularly stimulated by changes in government policy, chief among which were those of the 1960s[1] and of the 1990s. In both cases, new universities came into existence: in the 1960s, former Colleges of Advanced Technology became new universities and additional new universities were built on greenfield sites; in the 1990s, the former polytechnics and some other colleges of higher education were absorbed into the university system.

1.2 These two expansions were preceded by major social changes. The 1960s expansion had been preceded by the establishment of the welfare state and a commitment to support financially all students who had gained admission to a university (paying the university fee and a maintenance grant, the size of which was subject to a parental means test) and extended the principles of the welfare state to higher education; the 1990s expansion came after a period when the role of the state that had been accepted since 1945 had been re-examined. While the principle of direct government funding of universities had not been abandoned, by the 1970s it had become clear that the desired expansion of student numbers would not be accompanied by a pro-rata increase of government financial support. Since then the real value of the unit of resource paid by the Government to universities per home and European Union (EU) student year has steadily declined, and following legislation in 1990, a fraction of the maintenance grant for home students is in the form of a repayable loan.

1.3 Another significant change occurred in the 1980s with the adoption by, first, the University Grants Committee, then by its short-lived successor the Universities Funding Council, and finally by the Higher Education Funding Councils (HEFCs), of explicit formulae to arrive at the block grant for each university. The two largest elements in this are that for teaching and that for research. The first is based on the principle that each year a university should receive for each full time equivalent enrolled United Kingdom and European Union student a sum of money which depends on whether the student is undergraduate or graduate and which varies in amount for different subject areas, the largest being for medicine and lowest for non-laboratory subjects such as arts and humanities. In Scotland, but not elsewhere, excellence in teaching as assessed by special panels is rewarded by a small bonus. Funds for research are almost entirely dependent for each of 72 subject areas on the numbers of established staff, contract researchers and graduate students, with each individual category being suitably weighted, and are particularly sensitive to the quality rating on a five point scale accorded to each university in each subject area as a result of Research Assessment Exercises. The formulae used in Scotland and England are explained in the evidence from the Higher Education Funding Council for England (HEFCE) and the Scottish Higher Education Funding Council (SHEFC) (pp319-321, 350-352), and are open to modification based on experience. Their use has had a powerful effect on the research strategies of universities, which were quick to see the possibility of securing a larger block grant by achieving high scores in the Research Assessment Exercise.

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[1] The expansion of the 1960s is usually associated in the public mind with the 1963 Robbins Report, despite the fact that the expansion was well under way by that time.

1.4 In addition there has been a change of emphasis in the Government's view of the purpose of scientific research in universities. By the time of the 1993 science white paper *Realising our potential*[1], the policy of the Government was that, in addition to its traditional role of engaging in *basic* scientific research, the university sector should explicitly incorporate the strategic aims of "wealth creation" and "improvement of the quality of life". Universities, and their science faculties, now also have this aim in mind when conducting research, as do the Research Councils in their operations (including the awarding of research grants to universities). Furthermore, many universities were eager to increase their income by any means, including acting as contractors for research, and were finding a range of willing customers; and greater quality and volume of research attracted additional core funding from the funding councils in England, Scotland and Wales. It is therefore not surprising that since 1977-78 there has been a multiplication by a factor of 2.8 of the number of scientists[2] employed by the pre-1992 universities[3] on short-term contracts.

1.5 It is against this background that the Select Committee on Science and Technology undertook its enquiry into Academic Research Careers for Graduate Scientists.

---

[1] *Realising our potential: A Strategy for Science, Engineering and Technology*, HMSO, 1993 (Cm 2250).

[2] "Scientists" are defined in this Report as including those in faculties of science, technology, engineering, agricultural and veterinary science and sciences allied to medicine.

[3] The Report refers to what are called either the "pre-1992 universities" or the "old universities". These are the universities which were referred to as such before 1992. If Universities' Statistical Record (USR) statistics are published by discipline, they, and the science disciplines in particular, are commented upon and used. When such discipline splits are not published, all-discipline totals are used. For some data sets only information for Great Britain universities is available. These are typically about 95 per cent of the United Kingdom totals. Annotations make clear which data have been used.

CHAPTER 2 INTRODUCTION

2.1 During recent years there has been some concern in many quarters, from the Office of Science and Technology (OST) and learned societies to industry and many universities, about various aspects of how academic scientific research had changed in the 1980s and early 1990s. These concerns focussed on the lack of growth in numbers of established[1] academic staff, the large increase in the numbers of non-tenured staff employed almost exclusively in research funded by grants of short duration and the worry that women scientists were disadvantaged in both of the above (but in particular the latter) categories. Added to these concerns were various criticisms of the research training element of Masters' and PhD degrees as being inadequate and requiring modification to meet changing needs; to which the Government had responded by suggesting a pilot scheme from autumn 1995 known as the Research Master's degree (to be called the "MRes") to train scientists in methods of research between the end of their bachelor's degree and the start of their career or their PhD. Responses to the OST's consultation on the MRes scheme were divided.

2.2 In 1994 the Select Committee on Science and Technology appointed a Sub-Committee to look into these matters[2]. The Sub-Committee saw its tasks to be: (i) to establish the facts about the numbers of scientists in established positions and those employed on contracts of limited duration in United Kingdom universities and how these numbers had changed over time; (ii) to identify the advantages and disadvantages of any differing terms of employment between the two major categories of university graduate scientific staff; (iii) to consider the causes of any perceived major changes; and (iv) to propose any policy changes considered by the Committee to be necessary or desirable, whether remedial or otherwise.

2.3 Two factors contributed to determining the scope of the enquiry. The first of these was the existence of the enquiry into Medical Research and the NHS Reforms by the Select Committee's other Sub-Committee, chaired by Lord Walton of Detchant and whose Report was published in June 1995[3]. Consequently, the Committee was free to concentrate on natural science, engineering and technology and to pay less attention to medicine (without excluding biomedical and non-clinical research). The second was the fact that since 1992 the Higher Education system had expanded in terms of the numbers of students, staff and institutions by means of the incorporation of all former polytechnics as universities and the addition of over 50 colleges now eligible to receive funding from the Higher Education Funding Councils[4]; therefore, because the Committee required self-consistent statistical data it was decided to restrict the statistics, although not the evidence, to the pre-1992 universities.

2.4 The format of the Report is as follows: in Chapter 3 the Committee surveys the situation described in the above paragraphs, using a statistical analysis to set the scene; in Chapter 4 the Committee expands on the previous chapter by reporting the views expressed to it by its witnesses[5]; in Chapter 5 the Committee reports its opinion; and in Chapter 6 the Committee summarises its recommendations.

2.5 During the enquiry the Committee received most generous help from various organisations. We visited University College London (UCL) and the Imperial College of Science, Technology and Medicine. A group visited the United States of America and there met

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[1] The term "established" is used to imply holders of established posts eg Professor, Reader, Senior Lecturer, Lecturer, Demonstrator, Director of a Centre or Institute, or Assistant Director of Research, with expectation of continued employment, and having membership of an established pension scheme (usually the Universities Superannuation Scheme).

[2] The membership of the Sub-Committee is detailed in Appendix 1.

[3] *Medical Research and the NHS Reforms*, HL Paper 12, session 1994-95.

[4] The Higher Education Funding Council for England (HEFCE), the Scottish Higher Education Funding Council (SHEFC), the Higher Education Funding Council for Wales (HEFCW) and the Northern Ireland Higher Education Council (NIHEC).

[5] A full list of witnesses is printed in Appendix 2. All transcripts and memoranda produced for the Committee are printed in the accompanying evidence volume. References to evidence are made according to page numbers (p...) in the case of written evidence or to question numbers (Q...) in the case of oral evidence.

Representative George Brown Jr, former Chairman of the House Committee on Science and Technology and representatives of the Association of American Universities, the National Science Foundation, the National Academy of Sciences, the Universities Research Association, the American Association for the Advancement of Science, the University of Maryland at College Park, the Ben Franklin Technology Center of South Eastern Pennsylvania, the University of Pennsylvania, Massachusetts Institute of Technology and Harvard University. The Royal Society of Edinburgh hosted our evidence sessions in Edinburgh and a private meeting with eight academic scientists. The Committee would like to thank all of the above and all of the witnesses for their assistance in the enquiry, and would especially like to thank the staff of the British Embassy in Washington DC and of the British Consulate in Boston for their assistance in arranging the visit to the United States.

CHAPTER 3 THE PRESENT SITUATION

3.1 In this chapter the Committee deals with the staffing situation in United Kingdom universities, funding sources and related issues[1].

SCIENTIFIC STAFF IN UNITED KINGDOM UNIVERSITIES

3.2 The main statistics behind the Committee's enquiry are summarised below in terms of established and contract academic staff with teaching and research or research only duties. Thus in the last two decades there has been a significant trend in the universities toward the employment of contract research staff. The increase in the numbers of such staff has not been matched by the increase in the numbers of any of the other categories, and in the period 1977-78 to 1993-94 the two dominant employment categories in universities, established teaching and research staff and contract research staff, have shown increases in numbers of 2.3 per cent and 216.5 per cent respectively. The ultimate effect of this is that, as the Committee of Vice-Chancellors and Principals (CVCP) pointed out: "the number of people who complete research contracts in any one year is about 5 times the number of vacancies likely to arise in [established] positions" (Q1).

Table 1: Academic staff in all disciplines

	1977–78	**1993–94**
Established (*) - Teaching & Research	32,023	32,747
Established (*) - Research only	963	1,750
Contract (**) - Teaching & Research	1,682	2,826
Contract (**) - Research only	5,886	18,627
	40,554	55,950

(*) Wholly university funded
(**) Not wholly university funded
Pre-1992 universities of the United Kingdom – see also Appendix 4 section 1

3.3 Within the above figures are other significant statistics, concerning the age of staff, their grade, their discipline and their gender. These are dealt with below.

Age

3.4 Many of the permanent teaching and research staff were first employed as a result of the 1960s expansion of the universities. Around the turn of the century retirement levels will have risen significantly, thereby creating vacancies for which some contract staff could be successful applicants. For all the established staff in universities, the percentage of older staff has been increasing as shown in table 2. Moreover the percentage of those in the lowest grade fell from 62.1 to 55.2 between 1984-85 to 1993-94. These and other facts are evidence of an ageing staff with little recruitment of younger staff to established posts.

3.5 The average age of an established member of staff is higher than that of a contract researcher. In general, this is because it is usual before appointment to established posts for scientists to hold short term post-doctoral appointments as junior research fellows or contract researchers. However, some scientists enter their 40s or even their 50s without having made the transition, and some contract scientists have retired without ever having had an established position.

---

[1] See paragraph 2.3 for note on statistics.

Table 2: Established staff: % of total (all grades and disciplines)

	1984–85	1993–94
Over 40	63.3	68.9
Over 45	43.0	53.5
Over 50	24.9	34.0
Over 55	12.9	17.2

Grade

3.6 The increase in staff numbers has not been uniform across the grades. During the period 1977-78 to 1993-94, for the universities of Great Britain, there is clear evidence of grade drift within the established staff population. The number of professors and readers/senior lecturers has increased at the expense of lectureships, as shown in table 3. The trends in grading do not appear to be markedly affected by disciplines.

Table 3: Established and contract staff, 1977-78 to 1993-94 (all grades and disciplines)

		1977–78	1993–94
Established	Professors	4,047	5,337
	Readers & Senior Lecturers	7,908	9,392
	Lecturers	19,433	17,440
	Others	653	763
Contract[1]	RA4	179	466
	RA3	461	1,131
	RA2	4,538	14,374
	RA1	2,299	5,009

All Great Britain Universities – see also Appendix 4 section 2

[1] Contract research staff in universities are typically graded by five RA (Research Assistant) categories: RA1B, RA1A, RA2, RA3 and RA4. These are respectively equivalent to the following university titles: research student, post-doctoral assistant, lecturer, senior lecturer and professor. However, these grades are not always directly comparable.

3.7 Within physical, mathematical and biological sciences the total number of established academic staff has remained constant over most of the last decade. All that has changed, as figure 1 below clearly shows, is that they have grown older with some limited replacement in the 25-35 year age group. There is a clear "bulge" of staff recruited in large numbers during the expansion of the mid to late sixties moving through the system and who will begin to leave by normal retirement around the turn of the century. The picture for contract staff is quite different. The total number has not remained constant, but increased by 72 per cent between 1984-85 and 1993-94 and in a year or two could equal established staff numbers. This is reflected in the age profile where the average age is 15-20 years less than that of the established staff. It is also evident that more are staying in contract research than might have been expected. What is unclear is what proportion of those who leave contract research secure established academic positions. The ACOST report, *The Science Base, Research in the Universities*[1], contains an estimate based on staff "wholly university funded" in the year who were partially or not wholly university funded the year before. This has been around 4-5 per cent throughout the period 1977-78 to 1988-89 with a fall to about half of this around the time of the 1981 cuts.

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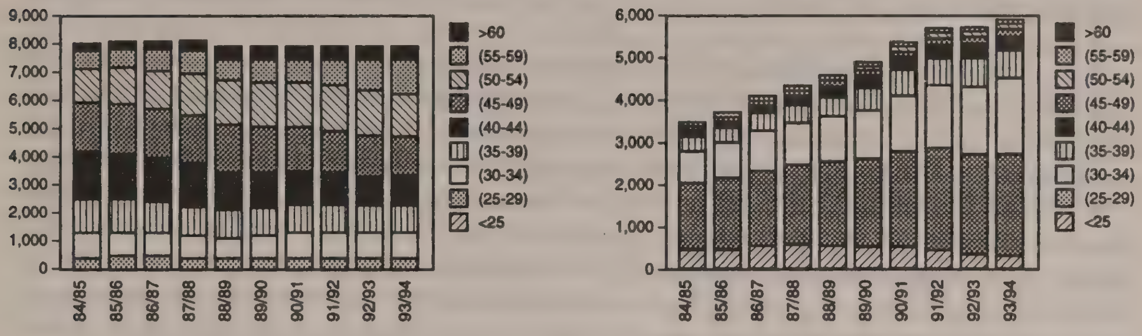
[1] *The Science Base: Research in Universities*, Advisory Council on Science and Technology, HMSO, 1992.

Figure 1: Established and contract staff in biology, mathematics and physical sciences: numbers and age profile changes in the decade 1984-85 to 1993-94

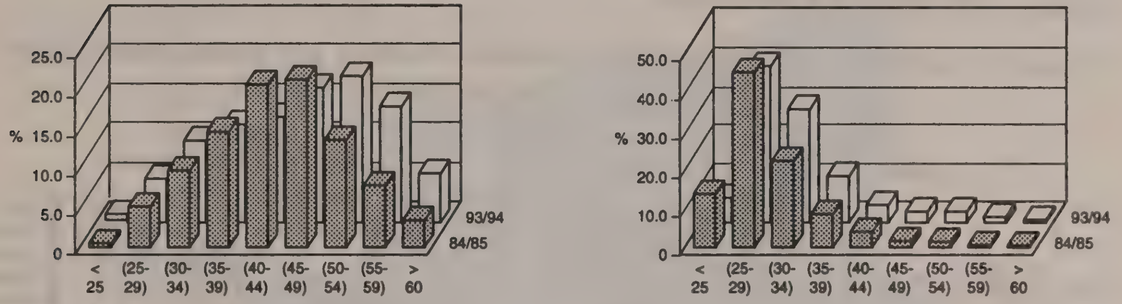


Established Staff
Academic Staff Numbers

Contract Staff
Academic Staff Numbers

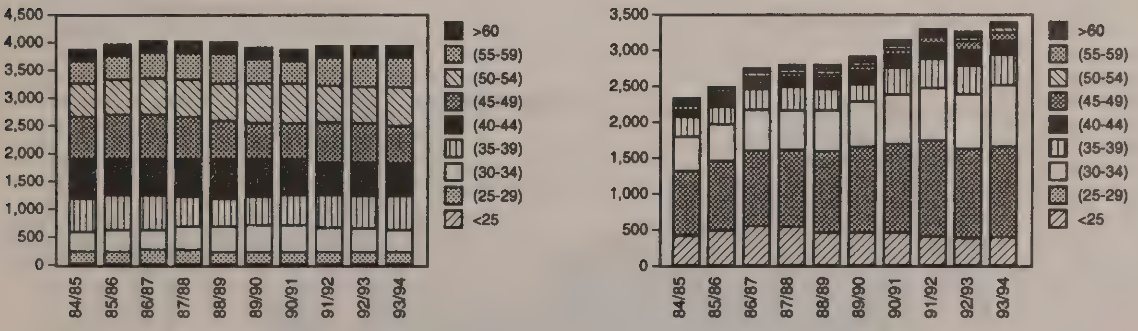
As % of Annual Total

As % of Annual Total



All United Kingdom Universities - see also data in Appendix 4 sections 3 and 4

Figure 2: Established and contract staff in engineering and technology: numbers and age profile changes in the decade 1984-85 to 1993-94

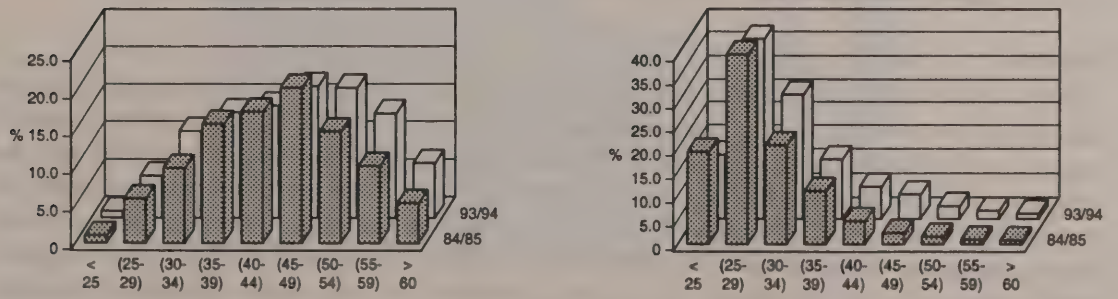


Established Staff
Academic Staff Numbers

Contract Staff
Academic Staff Numbers

As % of Annual Total

As % of Annual Total

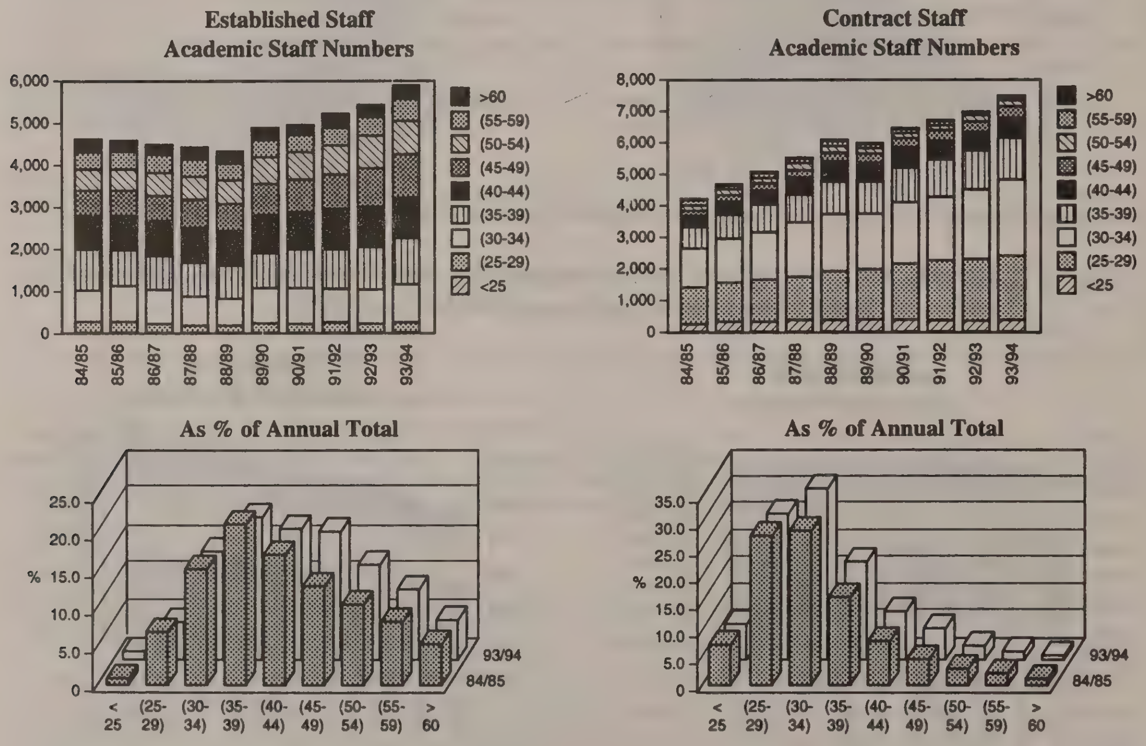


All United Kingdom Universities - see also Appendix 4 sections 3 and 4

3.8 The pattern in engineering and technology is that in the same period established staff numbers have remained constant but contract staff numbers have increased by about 55 per cent, and the age profile time shifts resemble with minor variation those for physics, mathematics and biological sciences with the same marked difference between age profile shifts for established and contract staff.

3.9 The number of contract staff in medicine, dentistry and health has almost doubled but established staff have increased by 20 per cent, almost entirely in the second quinquennium of the same period. This is, however, very largely due to National Health Service funding of clinical academic appointments. The age profiles also reflect the increase in established medical staff which resulted from the planned increase of medical student intake from 2,400 to 4,200 per annum which began in the early 70s and was complete by the early 80s. The contract staff age profiles are so similar as to suggest that, although the total numbers are increasing, many must have left the system. This would not be surprising because clinically qualified researchers frequently return to practice clinical medicine. However, many contract research workers in clinical departments are scientists without clinical qualifications.

Figure 3: Established and contract staff in medicine, dentistry and health: numbers and age profile changes in the decade 1984-85 to 1993-94


Established Staff
Academic Staff Numbers

Contract Staff
Academic Staff Numbers

As % of Annual Total

As % of Annual Total

All United Kingdom Universities - see also Appendix 4 sections 3 and 4

Destinations of contract researchers

3.10 Available data covering most of the last decade concerning the movement of contract researchers are shown in the histograms in figure 4. As expected, given the age profiles shown in figures 1 to 3 which show that about 84 per cent of these staff are under 40 years of age, the numbers retiring annually are very small. Contract staff leave for a large number of reasons; for example to go on to further education within and outside the United Kingdom, into employment (public and private sector) in the United Kingdom and abroad. The annual turnover of staff suggests that the *average* period of time spent as a contract researcher without change of employer is about four years. It is equally clear that a very small percentage may spend the whole of their working lives on short term contracts. It is reasonable to assume, despite the absence of statistical data, that these "career" contract researchers are those who are specialists in particular techniques and instrumentation.

3.11 Information on those who leave is available for some of the categories of most interest, as depicted in figure 5. One which has grown significantly comprises those (called "transfers" in figure 4) who move from one university to another but remain as contract researchers. In 1987-88 another large group comprised those entering industry in what was a boom year of the United Kingdom economic cycle, but since then there has been a steady decline to about half the peak. It may be conjectured that this decline mirrors declining recruitment by science-based industry in its in-house research and development activity during this period and may be related to an increasing tendency of that industry to go to other sources, including universities, for some of the knowledge it requires. About two per cent of the stock leave each year to go overseas and about 1.5 per cent go to industry. Undoubtedly some of those going overseas return but the proportion who return and how they are employed remains unknown.

Figure 4: Leaver Destinations: Contract Staff in all disciplines

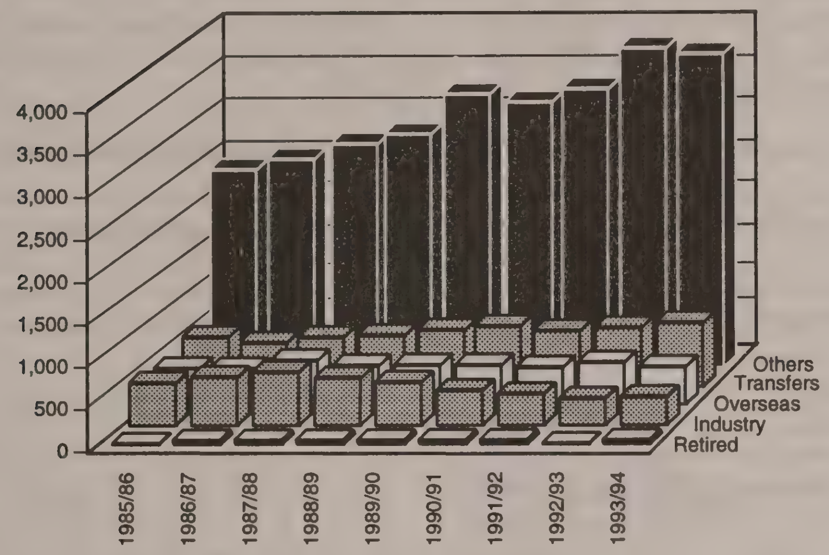
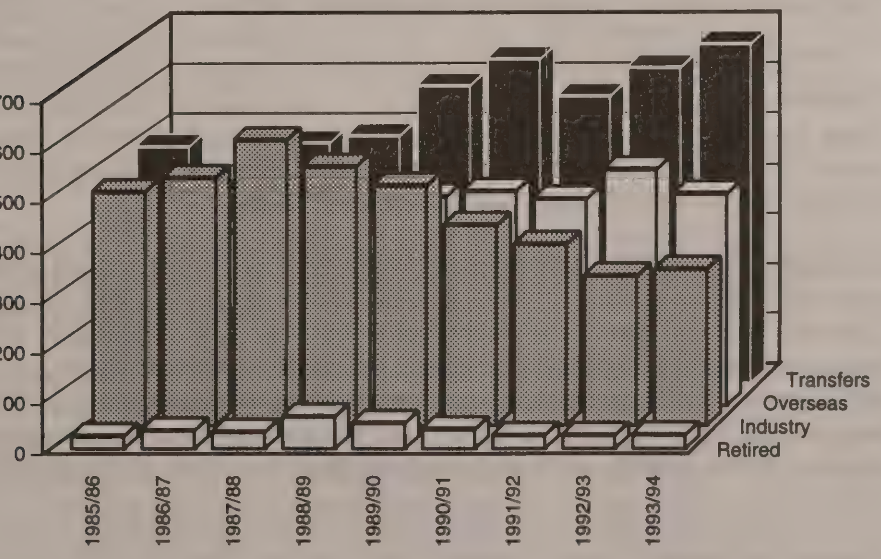


Figure 5: Selected Leaver Destinations: Contract Staff in all disciplines



Gender

3.12 The total number of male and female established and contract staff is shown in table 4[1]. There were changes in the proportions of women established staff from 10.1 per cent to 17.6 per cent and of women contract staff from 22.1 per cent to 32.7 per cent between 1977-78 and 1993-94. Much of the increased participation of women has occurred since 1987-88. The use of contract staff employment is dominant in scientific disciplines. Scientific staff comprised 55.6 per cent of established staff but 86.8 per cent of contract staff in 1993-94. Indeed, for science disciplines the numbers of established and contract staff are now almost equal, whereas in the non-science disciplines the ratio of established to contract staff is 5.4 to 1. The proportions of women in both science and non-science disciplines and of established and contract staff show similar patterns, but with the non-science disciplines being 5-10 percentage points greater, though the differences are getting wider. From these basic statistics it is obvious that women have been increasing their presence in academic scientific careers relative to men, and that while they have become more skilled at finding permanent postings, the main area of their growth of presence has been in contractual research. It remains true that, for every discipline, the percentage of men in permanent posts is always greater than the percentage of men in contract posts. For women the reverse is always observed.

Table 4: Established and contract staff by gender for all disciplines

	1977–78	1993–94	Women as % of total: 1977–78	Women as % of total: 1993–94
Established - men	28,789	27,125	89.9	82.4
Established - women	3,252	5,807	10.1	17.6
Contract - men	5,825	14,121	77.7	67.3
Contract - women	1,652	6,859	22.1	32.7

All Great Britain Universities – see also Appendix 4 section 2

3.13 In addition, as Table 5 shows, most of the growth in the numbers of women entering scientific careers has been at the lower end of the academic gradings. Men are dominant in number in the three senior grades. It is only below the level of lecturer that women and men are found in similar numbers.

3.14 The proportions of men and women vary much according to discipline. Numerically, women are best represented in biological and medical sciences, and least represented in physics and mathematics[2].

FUNDING SOURCES AND DESTINATIONS

3.15 There have been major changes in the relative amounts of university income from different sources. This is illustrated in the two pie charts for 1989-90 and 1993-94 (figure 6) for which the total incomes in 1993-94 prices were £4.97bn and £5.9bn.

3.16 Care needs to be exercised in interpreting the trends because some of the changes are due to government policy of, for example, switching some funds from the Funding Councils to the Research Councils. That said there is no doubt that in this four year period there was a very significant increase (exceeding 20 per cent) in annual income from research grants and contracts derived from Research Councils, government departments, research charities and industry. We were told (Q20) that over the longer period from 1979-80 to 1992-93 there was a real terms increase of 165 per cent. Most of this income was gained as the result of the efforts of about 20,000 of the

---

[1] Detailed gender-related statistical evidence is provided by the Gender and Science, Engineering and Technology (SET) Project (pp300-304).

[2] See section 5 of Appendix 4. These comments refer more to the percentage of women who graduate than to employment trends.

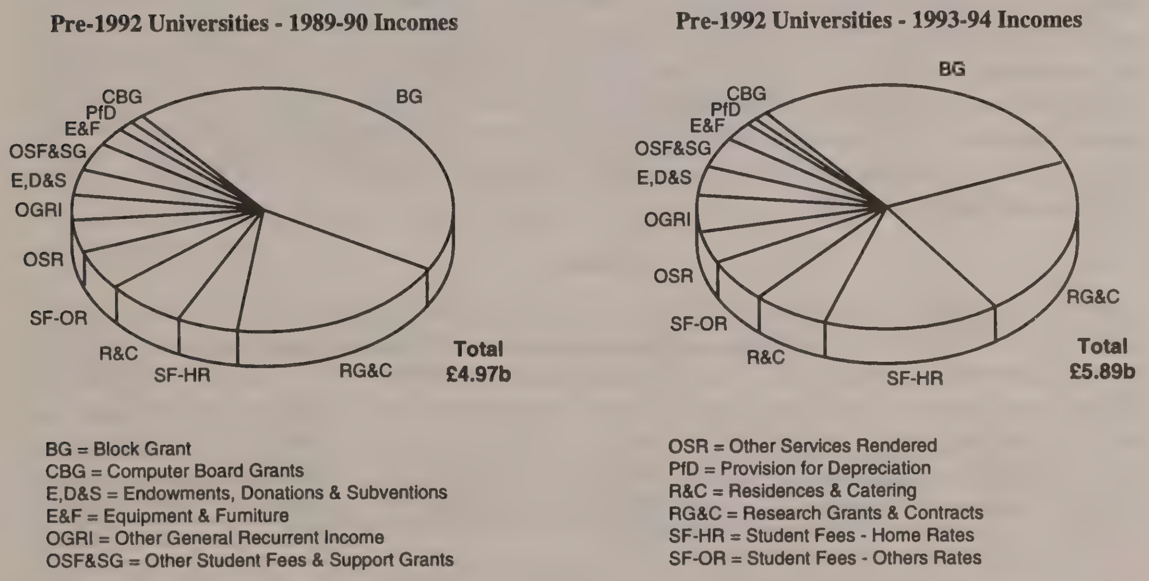
32,000 established staff and now amounts to, on average, about £60,000 per annum per established scientific academic staff member.

Table 5: All disciplines (with percentage of total numbers in parentheses)

	Men		Women	
	1977–78	1993–94	1977–78	1993–94
Established - Professors	3,963 (97.9)	5,047 (94.6)	84 (2.1)	290 (5.4)
Established - Readers & Senior Lecturers	7,410 (93.7)	8,393 (89.4)	498 (6.3)	999 (10.6)
Established - Lecturers	16,969 (87.3)	13,303 (76.3)	2,464 (12.7)	4,133 (23.7)
Established - Others	447 (68.5)	378 (49.5)	206 (31.5)	385 (50.5)
Contract - RA4	174 (97.2)	437 (93.8)	5 (2.8)	29 (6.2)
Contract - RA3	416 (90.2)	871 (77)	45 (9.8)	260 (23)
Contract - RA2	3,680 (81.1)	9,887 (68.8)	858 (18.9)	4,487 (31.2)
Contract - RA1	1,555 (67.6)	2,926 (58.4)	744 (32.4)	2,083 (41.6)

All Great Britain Universities – see also Appendix 4 section 2

Figure 6: Changes in sources of total income in United Kingdom universities between 1990 and 1994



Pre-1992 Universities - 1989-90 Incomes

Pre-1992 Universities - 1993-94 Incomes

BG = Block Grant
CBG = Computer Board Grants
E,D&S = Endowments, Donations & Subventions
E&F = Equipment & Furniture
OGRI = Other General Recurrent Income
OSF&SG = Other Student Fees & Support Grants

OSR = Other Services Rendered
PfD = Provision for Depreciation
R&C = Residences & Catering
RG&C = Research Grants & Contracts
SF-HR = Student Fees - Home Rates
SF-OR = Student Fees - Others Rates

All United Kingdom universities - see also Appendix 4 section 8

3.17 Of this total, medicine and allied subjects attract almost 40 per cent, with mathematical, biological and physical sciences accounting for about 32 per cent and the engineering disciplines accounting for about 15 per cent.

3.18 The handling of the very large number of grants and contracts, involving such large amounts of money from so many different "customers" and often with very different aims, imposes considerable burdens of accounting and management on universities, requiring much more sophisticated administrative as well as overall university research policy-making structures. There is also a cost of managing this complexity both for the universities and their funders. We shall comment later on the adequacy of these for management of research contract staff.

Funding councils

3.19 In 1995-96 funding councils will allocate a total of £4519.8m to universities. This figure incorporates £3613m in England, £239.6m in Wales, £549m in Scotland and £118.2m in Northern Ireland.

3.20 The methods of allocating this money vary according to the Funding Council, but in the most part funding is allocated according to formulae. For England in 1995-96, £2,268m was allocated for teaching, based on the maximum allowed numbers of home and European Union students and not being weighted for quality; £636m was allocated for research, weighted according to (a) the volume, (b) the cost of research in individual subjects and (c) the quality of that research as measured in the Research Assessment Exercise; and £298m was distributed on a non-formula basis. Of the research money, £600m was allocated for quality research, £20m for generic research and £16m to encourage research potential in selected areas.

3.21 In Scotland, universities are funded on a different basis, in that the teaching element of funding contains an element of discrimination for quality. Universities with an "excellent" rating in teaching in a subject are permitted to have an additional five per cent of funded places in that subject. The research quality formulae differ: that for England and Wales adds one cash increment for each step up the quality rating ladder with that for Scotland according a 40 per cent increase[1].

Research councils

3.22 In 1993-94 the research councils[2] provided £436.4m to scientific research in universities, compared with £283.6 five years earlier[3]. Most of this was either in response to applications from individual staff members or in support of research chosen by the councils as being important. In both cases an influential factor in arriving at decisions is peer judgment. For the Research Councils, for 1992-93 and onwards there are increases due to a transfer of money from Funding Councils to Research Councils. Although financial breakdowns by Research Council are not available, in terms of the funding of contract staff the position is as shown in table 6 for 1993-94, along with the percentage of women funded.

Table 6

	Contract staff funded	% of women funded
AFRC	550	39.8
ESRC	510	44.9
MRC	1,585	42.8
NERC	518	26.3
SERC	4,075	15.9

Contract staff for all Great Britain universities for all disciplines - see also Appendix 4 section 7

Government departments

3.23 In 1993-94 government departments contributed £153.3m to scientific research in universities, compared with £138.6m five years earlier[4].

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[1] For fuller comments on the differences between English and Scottish funding formulae, see evidence from HEFCE and SHEFC (pp319-321, 350-352).

[2] In that year there were five research councils, which on 1 April 1994 were rearranged to the Biotechnology and Biological Sciences Research Council, the Economic and Social Research Council, the Engineering and Physical Sciences Research Council, the Medical Research Council, the Natural Environment Research Council, and the Particle Physics and Astronomy Research Council.

[3] Comparison expressed in real terms based on 1993-94 prices.

[4] Comparison expressed in real terms based on 1993-94 prices.

Industry

3.24 In 1993-94 industry contributed £131.4m to scientific research in universities, compared with £122.5m five years earlier[1]. The time series of this funding is detailed in the statistical annex. In comparison with the amounts spent on R&D by industry, £9.07 billion from all sources, the sums are small. The percentage of total research grant and contract income funded by industry is declining at a time when industrial competitiveness and wealth creation feature strongly in government policy initiatives.

The European Union

3.25 Funds to United Kingdom universities deriving from European Union sources have increased greatly in recent years: in 1993-94 the sum was £101.9m, compared with £47.5m in 1989-90[2]. This trend will undoubtedly continue provided the quality of United Kingdom university research continues to be perceived in Europe as excellent. Disciplines favoured by EU funding in the universities include medicine, computing, other biological sciences and electrical and electronic engineering. However, the grants do not provide full cost and can therefore represent a drain on university income. In comparison industry is estimated to receive £104m from EU research programmes. Funds from other overseas sources outside the EU are now declining in real terms: these monies favour medical studies and especially institutions in London.

Charities

3.26 Charities spent £293.6m in universities in 1993-94, mostly in areas of medical research, compared with £174.4m five years earlier[3]. In 1993-94 the member charities of the Association of Medical Research Charities (AMRC) spent £317m on research. Of this, £185.4m was spent in universities (including medical schools), and a further £49.4m was spent in directly-funded units, many of which were based in university hospitals. Many of these charities have large research budgets, and one of these, the Wellcome Trust, is particularly notable, spending £115.9m in 1993-94 on medical research (p282) thanks to an endowment from the founder of the Wellcome pharmaceutical company, Sir Henry Wellcome[4]. Also notable are the Cancer Research Campaign and the Imperial Cancer Research Fund, which respectively spent £48m and £53.9m on medical research in 1993-94.

3.27 Most AMRC non-capital funding is in the form of short-term support for specific research projects, fellowships and other similar types of funding (p282), although some charities have funding schemes which offer long-term or more general funding, for example in the form of core grants for departments or units, the support of named or endowed chairs, or rolling programme grants. The effect of this is that the charities within the AMRC currently support around 4500 individuals in research including clinicians and basic scientists, support staff and professionals allied to medicine, in senior appointments as well as in training posts and short-term research posts (p282).

ISSUES HIGHLIGHTED BY THE 1993 SCIENCE WHITE PAPER

3.28 In the following paragraphs, the Committee outlines some of the concerns associated with the situation as detailed by the Science White Paper. These concerns are not necessarily shared by the Committee, and are considered more fully in the next chapter.

3.29 The Science White Paper, *Realising our potential*, drew attention to the rise in the numbers of contract research staff in paragraphs 7.26 to 7.31. It pointed out that such a trend was not unique to universities and claimed that "Many employers have found that there are advantages in this arrangement. It provides employer and employee with greater flexibility and encourages more mobility between employers and between sectors"[1].

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[1] Comparison expressed in real terms based on 1993-94 prices.

[2] Comparison expressed in real terms based on 1993-94 prices.

[3] Comparison expressed in real terms based on 1993-94 prices.

[4] The Wellcome Trust expected to spend in excess of £200m on medical research in 1994-95 (p47), and the Trust is the source of about 30 per cent of the total money committed each year to funding biomedical research (p48).

3.30 However, *Realising our potential* also drew attention to potential areas of concern caused by the present situation:

> "For the universities and the purchasers of research, the quality of work may suffer if too much effort is expended in recruiting and training new staff. The evidence suggests that many contract staff have ambitions for a long-term career within universities, something which is realistic only for a small proportion. Such individuals may diminish their employment prospects in other fields by taking a succession of short-term contracts. While individuals must remain free to exercise choice in such matters, they ought to do so with the benefit of professional career advice and counselling"[2].

THE RESEARCH MASTER'S DEGREE

3.31 The Research Master's degree was announced by the Government in 1993 in the Science White Paper. It was proposed as a result of concern that "the traditional PhD does not always match up to the needs of a career outside research in academia or an industrial research laboratory"[3]. The proposed new degree, taking one year to complete, is intended to "provide an opportunity to acquire extra knowledge and skills, either in preparation for a period of research training leading to a PhD or for employment"[4], and the Government sees the following advantages in the arrangement:

- "it will allow more students to be supported to Master's level, through which they can acquire skills of value for a range of careers within industry or elsewhere;
- students will have an opportunity during this year to consider whether they have the wish or aptitude to proceed to research leading to a PhD degree;
- applicants for PhD training can be selected on a more informed basis by reference to their personal motivation, ability to benefit from PhD training and suitability for either an academic or non-academic career."[5]

The MRes would be primarily a research degree, but would place significant emphasis on broadening skills in such areas as communication, management and information technology (Q145). It is not the Government's intention that the degree should be a prerequisite for a PhD (p21, Q147).

3.32 The Research Master's degree is being tried out in the 1995-96 academic year as a pilot scheme. At the time of writing, 35 schemes were being set up in 23 universities, and it is expected that 275 students will be enrolled on them.

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[1] *Realising our potential*, paragraph 7.27.

[2] Ibid., paragraph 7.28.

[3] Ibid., paragraph 7.16.

[4] Ibid., paragraph 7.21.

[5] Ibid., paragraph 7.21.

CHAPTER 4 SUMMARY OF EVIDENCE

4.1 The Committee sent to prospective witnesses its call for evidence and heard oral evidence. The call for evidence is printed in full in the evidence volume (p vi), and the list of witnesses is printed at Appendix 2. In this chapter, we summarise the evidence received.

CONTRACT RESEARCH STAFF: GENERAL ISSUES

Advantages of short term contracts

4.2 The system of short term research contracts allows those funding research a substantial degree of flexibility[1], and is therefore in some ways an efficient way of commissioning research. The AMRC noted that it "enables charities to target their support for research to proposals of relevance to their objects" (p282), and Dr Anne Wright, Vice-Chancellor of the University of Sunderland, regarded it as

> "likely to be for many institutions the most efficient way of meeting teaching and research objectives. The benefits to science, and to external funders and commissioners of scientific projects including research councils, are that this is a sharply focused, performance based system, which is task and output oriented" (p89).

Thus research can adapt more rapidly as fields and priorities change (Q15). The system also means that "unsuccessful research does not waste more money" (p355[2]), and allows the employer or funder of research freedom to commission that research from the best team (p186). According to the Royal College of General Practitioners, "a major advantage is that a research worker who goes off the boil or loses enthusiasm or skill can be easily removed without any contractual or redundancy problems" (p346). This is a real benefit, as the Royal Society of Chemistry notes when it states that "During boom periods, such as the 1960s, some appointees may be of modest quality, particularly if industrial demand is high" (p213). By contrast, where a member of staff in an established post becomes unproductive, such problems are a concern (p1), and this has led some to conclude that "the permanent contracts of academic staff possibly provide staff with too much security" (p293)[3]. The Natural Environment Research Council (NERC) considered that "Turnover is essential to the dynamism and vitality of the research community" (p65) and other witnesses stated that with fixed term contracts "Research teams are refreshed by the regular injection of new blood" (p271[4]), and the science base is provided with "a large work force of able and enthusiastic young people" (p273[5]).

4.3 Benefits for the research scientists on fixed term contracts were also noted, especially for those at the early stages of their career. The system encourages mobility[6] at a time when it is generally essential that a scientist picks up experience and takes up opportunities before deciding on his or her vocation. The Engineering and Physical Sciences Research Council (EPSRC) believed that "The concept of maintaining a healthy turnover of young researchers in academia or fixed-term contracts is basically sound" (p76)[7]. Dr Elizabeth Johnson, Co-ordinator of the Daphne Jackson Memorial Fellowships Trust, notes

> "Employment on a research contract is a normal and important part of the training of a good research scientist who may want to make this a long term career, and who has just finished a PhD...It also allows young researchers the time and opportunity to discover their aptitude for an academic/and or research career" (p327).

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[1] See pp65, 89, 113, 130, 139, 148, 165, 171, 186, 213, 291, 322-3, 325, 346, 349; Q532.

[2] School of Electrical Engineering, Queen's University of Belfast.

[3] Department of Physics, University of Oxford.

[4] AEA Technology.

[5] University of Leeds.

[6] See pp113, 130, 278, 291, 349.

[7] See also p129.

The University of Leeds believes the system "provides a testing and selective environment which should lead to the subsequent employment of the very best academic scientists in higher education in the future" (p273). Short term contracts "allow for changes of the subject of the research of individual researchers, which broadens their experience and improves their chances for future employment in industry" (p317[1])[2].

4.4 In summary the Medical Research Council regarded the above as "major strengths" (p130) in the career structure which should not be lost, and believed that "the use of short-term appointments in the immediate post-doctoral stage provides an appropriate environment in which young scientists can assess for themselves, and demonstrate to potential employers in the scientific community, their suitability for the exceptional demands of longer-term careers in research or academia" (p129).

Disadvantages of short term contracts

4.5 The overwhelming complaint concerning short term contracts in academic research was that a situation had developed in which there was no longer a perceivable career progression for scientists. The Royal Academy of Engineering noted that "the number of people on short term contracts is out of all proportion to the permanent posts which may become available" (p165) and the Save British Science Society noted that "The majority of those in the pool of post-doctoral research scientists and engineers will not succeed in getting an academic or permanent Research Support post" (p228). The Chemical Industries Association noted that "many young researchers have come to conclude that there are no real career structures available to them in academia, merely the prospect of a succession of relatively insecure contract positions" (p285), and this opinion was widely repeated[3]. This led to a feeling among scientists that there was no security in academic science, which could be, and often was, demoralising: the Conference of Medical Royal Colleges (CMRC) noted that "Short term funding, while appropriate for the needs of graduates in the early stages of their careers, for example in acquiring their research qualifications and exploring their vocations, becomes a powerful disincentive to continuing in research when family and other financial responsibilities have been accumulated" (p292)[4].

4.6 That last statement from the CMRC hints at the section of scientists most badly affected by the situation: those who are on fixed term contracts beyond an age where, at the beginning of their career, they might have assumed that they would have achieved established positions. A succession of short term contracts into and beyond the early thirties not only had the effect of creating a feeling of insecurity, but could often adversely affect a scientist's future prospects: the Department of Health noted that "Scientists that undertake a series of short-term contracts are perceived as having no real career history and may therefore find it difficult to obtain more senior positions" (p296), and other witnesses noted that this was relevant not only to cases where scientists were attempting to progress within academia but also from academia to industry[5]. Witnesses were also alarmed by the consequences of one development in particular, namely that researchers should be paid according to age-related pay scales: this frequently worked against older scientists where the funder insisted that only a certain level of salary could be provided for by a grant, meaning that some older scientists were ineligible for a particular contract on the grounds of their age alone: as Professor Michael Springford, Head of Physics at the University of Bristol, put it, "To be told, at the peak of one's scientific productivity, that one is ineligible for further funds simply because of age, has no scientific or other justification, and can be painful" (p356). He, along with others[6], wished to see the end of this practice.

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[1] Dr I Hardalupas.

[2] See also pp317, 340, 365.

[3] See pp33, 89, 197, 228, 252, 316, 325.

[4] See also pp33, 89-90, 316, 346-7; QQ430, 1100.

[5] See p1, 129, 316, 361; Q27.

[6] See pp140, 327, 366.

4.7 Salary levels were also a cause of complaint, in two respects. The first of these was that many felt them to be too low[1], especially when compared with comparable figures for graduates in industry and elsewhere (see paragraph 4.26 below). The second was that the system of pay scales for research appointments was being abused. The CVCP acknowledged that complaints had been made (p1-2), but universities were not always seen as the culprits: Dr Elizabeth Johnson stated

> "While universities appear to have been scrupulous about advancing researchers through the appropriate salary scales on a given contract, they have at times appeared powerless in the face of a decision by a Research Council, in funding a researcher on a named contract, to fund a post at the minimum point on the scale" (p328),

and the Association of University Teachers (AUT) claimed short term contract scientists "are generally asked to sign waiver clauses so that a succession of contracts does not lead to accrued employment rights" (p33). The AUT were particularly concerned about those on lower grades, such as RA1B[2], stating that "We are aware of a very, very significant number of people who do not get all the increments year by year when they are on the grade" (Q229).

4.8 This view was echoed in statements concerning the status of contract research staff in other university structures. The AUT stated that "most contract research staff are excluded from collegial mechanisms within their universities" (p34), and some contract research staff saw their relationship with established staff in "us and them" terms, with contract scientists being regarded as less than the equals of the established staff (pp316-317)[3]. One retired scientist with thirty years' experience of short term contracts, Mrs Marjorie de Reuck, noted "It is frequently said that fixed-term researchers are temporary staff employed for only 2 to 3 years, and so have no rights or responsibilities for the future of their institutions. This is not an argument which is used about student participation" (p341). She also noted the very important effect of status on morale amongst scientists, and the positive effect of uniform titling by grade irrespective of whether a scientist is on a fixed term or open-ended contract (pp340-341).

4.9 Other witnesses stated that another area where contract research staff were abused was in their working relationship with their team leaders. ICI felt that they "often seem to be used as hired hands by the principal researchers who direct their work, with little thought being given to their personal and professional development" (p323), and this was echoed by the OST (p18).

4.10 Scientists on short term contracts were also prevented from optimising their personal development by the amount of time that they had to spend on searching for new contracts, and this could often have a deleterious effect on the quality of their work[4]. The Association of the British Pharmaceutical Industry (ABPI) considered that "A three-year contract may produce as little as 12-18 months of good work" (p148). The Committee of Scottish Higher Education Principals (COSHEP) said that "candidates are no sooner established into their project than they are forced to start seeking their next source of employment" (p197)[5]. This bad effect on the quality of work was often compounded by the poor morale[6] which contract research staff often suffered. Features of the process of applying for contract after contract included the prevention of contract staff from establishing their own research bases (p291) and the need to produce papers by which their applications could be judged. These papers had to be produced quickly and had to be publishable (and sometimes tended to avoid themes deemed to be risky and original), leading occasionally to bland science or short term results at the expense of long term research[1]; a recipe for mere extension of existing knowledge and the enemy of riskier, more speculative and original research[2].

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[1] See pp139, 148, 165, 171, 197, 213, 226-7, 274, 277, 316, 366; Q237.

[2] ie the grade normally associated with graduate research assistants rather than postgraduates. Many may be studying for higher degrees.

[3] See also p65.

[4] See pp90, 291-2; Q785.

[5] See also p309.

[6] See pp323, 341, 366.

4.11 A further complaint concerned those scientists who found themselves out of work between contracts. It was argued that "bridging funding" between contracts would help remove some of the anxieties for those who found themselves in such a situation, as it was common to experience a short period of unemployment[3]. This practice is not widespread in the United Kingdom[4]. An adverse effect of the high chances of being out of work between contracts was the difficulty of obtaining a mortgage[5].

4.12 A serious consequence of the above might be that young scientists would be discouraged from entering into academic careers. The Royal Society of Edinburgh stated that "it is particularly important that people see a good career structure in science. If there is a discouragement to enter the profession then I think you will not attract the highest quality people" (Q801)[6]. Alternatively, they might seek employment in other countries, thus forming a "brain drain"[7]. However, while the AUT noted that "if the very best of our scientists know that they can get that security and that income elsewhere they will choose not to do it in the United Kingdom or in the university sector" (Q187), most evidence of an exodus of British scientists to the United States or elsewhere was insubstantial; indeed the Wellcome Trust noted the large interest in its long term fellowships from other countries, indicating the existence of what might be called a "reverse brain drain" in some areas. The Trust argued that, because of its schemes, "one of the attractions of coming here is that they can get secure funding for a longer period of time and they feel that that actually makes the possibility of them doing research with real innovation much more realistic" (Q274)[8]. But fears that the current situation would discourage future scientists were more widespread: the CVCP feared that "graduates will increasingly be unwilling to undertake post graduate research degrees" and that, realising that there was little future in science, would go into non-scientific areas such as finance (p3)[9], and the Biotechnology and Biological Sciences Research Council (BBSRC) said that "Evidence from secondary school careers advisers indicates that the perception of science as an insecure and poorly rewarded occupation has been particularly damaging on the career choices of the brightest students, whose range of options is widest" (p112).

The effect of foreseeable retirements

4.13 There was recognition in some quarters that a large number of retirements due among established staff would perhaps cause an amelioration of the situation by creating a significant number of vacancies[10]. The encouragement by SHEFC of early retirement had created some 300 vacancies in established posts in Scotland in 1995 (p350). However, it was felt that retirements would not in general cause the system to right itself (p272). ICI believed that

> "If retirement were fixed at a more reasonable age, and the system of Emeritus appointment more widely used to retain those whose scholarship remains an asset, then in the short term at least, some more career movement could take place" (p323).

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[1] See pp293, 325: QQ743, 812, 1026.

[2] See, however, SHEFC's comments in response to Q1026 (p353).

[3] See pp197, 325, 341; QQ1250, 1342.

[4] The Committee were told in the United States that the longer tradition of short term funding there (comparative to the United Kingdom) had allowed a system of bridging funding to develop.

[5] See pp171, 186, 278, 349.

[6] See also pp47, 65, 112.

[7] See p89; QQ210, 1131.

[8] Additional surveys (eg by Jack H Schuster in *Higher Education*, vol. 28, pp 437-452, 1994) confirm that many United Kingdom academics, especially young ones, *consider* emigration but there is no firm information on the proportion or quantity of permanent emigrants.

[9] See also pp282, 286, 291, 346.

[10] See pp33, 165, 197, 214, 275, 279.

Some considered that it was not always certain that as older established staff retired they would be replaced by new staff on open-ended contracts.

New developments

4.14 In the absence of the system righting itself, some new initiatives were being established. The OST particularly welcomed the decision by the University of Warwick to fund 50 new research fellowships[1] (Q106), and these fellowships, along with similar long term fellowships funded by the Royal Society[2] and the Wellcome Trust[3] were widely welcomed by those, such as the CVCP, who favoured such initiatives (Q9). The Confederation of British Industry (CBI) believed that moves towards more "tenure-track" appointments (a system widespread in the United States) would be beneficial (p290).

Career development

4.15 Witnesses frequently recognised that there was a need to improve the co-ordination of career development for science graduates, whether or not they wished to remain in academic science or move on to positions in industry and other fields[4]. The University of Leeds said that

> "If it is not feasible, under any realistic circumstances, to provide a coherent career for the majority of graduate research scientists within the academic system, then we must necessarily focus on maximising opportunities to enhance their employment potential in relevant and appropriate jobs outside higher education. Such mobility may, in any event, be a desirable national objective" (p272).

4.16 It was generally felt that science graduates were often regarded differently from other students by their supervisors in that they were expected to use their science degrees to continue in directly related fields: a science graduate going into finance or commerce was sometimes felt to have wasted his training, but this was less frequently a criticism aimed at a history graduate going into the City. One view which was alleged to be held by many of those teaching and supervising contract scientists was that they wished to make them "clones" of themselves by encouraging them to take very similar career paths: one American described their attitude in terms of "it's what we wanted to do so why shouldn't they want to do it too?"[5]. Such people rarely sought to encourage scientists to widen their horizons: Glaxo felt that "diversification of interests is not encouraged" (p305). Professor Sir Arnold Wolfendale, President of the Institute of Physics, considered that "there needs to be a sea-change in attitude, that a university education...should be equally in preparation for industry or commerce as well as in preparation for university research and a permanent job in the university system" (Q665).

4.17 Science graduates were also considered to lack certain skills which would make them able to transfer between jobs: Professor Howard Newby, Vice-Chancellor of the University of Southampton, felt that many contract staff in scientific research were "virtually unemployable elsewhere" (p252) and that "their skills are not transferable elsewhere" (p253). For example, compared to humanities graduates, they were felt to be ill-suited to careers where communication and presentation skills were necessary (Q1253), and to be lacking in other areas: they were often poor at negotiating and administering, and at conversing in other languages. Sadly, it was felt that some were poor at writing and other skills which should have been developed before university. Glaxo said that recruits "often lack skills in areas such as report writing, communication/presentation, basic use of information technology and team working and organisation" (p305)[1]. Some scientists were felt to have too narrow a base of skills, either through their dedication to one particular (but obscure) research field or through a lack of wide experience. The Royal Society of Chemistry wrote "The suitability of contract researchers for many possible forms of employment may depend on the breadth of their training and experience prior to contract work, and the nature of the contract work. Retraining of some contract workers may be required, particularly of those who have spent some years in a very narrow specialisation" (p213). ICI pointed out that even in one area in which academic staff would often be expected to be able to excel, teaching, there was a need for more training: they noted "It is perceived that very few academic staff receive any training in teaching skills, or indeed in the supervision of research" (p323). The Royal Society said that "All too often, researchers on short term contracts are left to look after their own careers with little formal guidance from the institutions in which they work" (p240).

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[1] Not all of the University of Warwick's fellowships are in scientific disciplines: one quarter are in areas outside the sciences and social sciences (Q1318). 36 of the 50 fellowships were awarded in 1995, with the remainder to be contested for in 1996, and 2,000 applications were received. The successful candidates came not only from the United Kingdom, but also from Australia, Denmark, France, Germany, the Netherlands, India, Israel, Russia and the United States. The University of Leeds was also establishing a similar scheme (p273).

[2] See Q1175.

[3] See p48.

[4] See Q332.

[5] See also Q1295.

4.18 Many felt that there was a great need to give scientists better career advice from an early stage. The Wellcome Trust argued that "Universities must bring on stream their own career development schemes and improve their ability to manage human resources" (p48) and the OST noted that "A key step is to provide better advice to contract research staff which makes clear the limited opportunities in academia and the possibility of alternative career paths" (p18). For those who entered into academic careers through the short term contract system, this advice was particularly necessary, yet universities often overlooked its importance: Professor F W Bullock of University College London (UCL) said

> "We cannot conceal from you the fact that universities have been somewhat lacking in providing proper advice to contract research staff in the past. Many members of contract research staff have been employed continually on short term contracts without actually having ever been told that this is not going to lead to anything more permanent in the future" (Q32).

It was felt that contract research staff often had unrealistic long term expectations, and required better appraisal of their prospects than they currently received (Q171). Some universities had recognised this problem, and were developing schemes whereby those with less good prospects were counselled at an early stage and helped with career moves. Among those were UCL, whose scheme's principal features are described below:

> "One of the inherent and crucial parts of the scheme we have developed at University College London is to make sure that the contract researcher is aware at all points in his career, up to the point when he might or might not be taken on, not just of how he is doing in research, but also of the fact (if this is the case) that there is very little prospect of him actually being taken on eventually as a member of staff...The contract research staff member, after three years, has a pretty good idea of whether he is going to be on course for consideration for permanent employment, or whether in fact he is not. At the most he will have spent only three years of his employment with us, and can then think about going out to some other career, rather than trying to pursue an academic career which he may not be suitable to or capable of" (Q32).

UCL's scheme was widely applauded by other witnesses[2]. In addition,the University of Edinburgh had run career counselling workshops for contract research staff (QQ 949, 954) and the University of Strathclyde had piloted a career development course for short term contract staff (p359).

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[1] See also p308.

[2] See pp48, 229, 240; QQ1153, 1189.

Whose responsibility?

4.19 Certain factors and policies were felt to have prevented an amelioration of the situation. The Research Councils were blamed for failing to take proper account of the effect of their funding mechanisms on the contract research staff undertaking their work in universities. Witnesses also noted the effects of the funding formulae used by the Funding Councils in allocating money to universities. It was claimed that the HEFCE's formulae did not reflect realistically the contribution of contract research staff to university research (p330).

4.20 Charities pointed out that they were often unable to allocate long-term funding as their resources were often unpredictable. The AMRC noted that

> "The balance between short-term funding and long-term opportunities appears to be wrong but the provision of long-term support presents particular difficulties for the "collecting tin" charities which, in general, fund grants from recurrent income rather than from endowments or interest on capital. For such charities five years is "long term" in financial terms" (p283).

4.21 The universities, research councils and the AUT spoke of their attempts to agree a concordat whereby contract research staff would be treated according to certain guidelines. The CVCP noted

> "Solutions to the strategic, the salaries/conditions and Research Councils' concern issues will only be found through co-ordinated action by "employers" and "funders" based on a much clearer definition and explanation of the respective responsibilities expressed through model contracts of employment on the one hand and revised grant regulations on the other" (p2).

However, progress towards a concordat which could be implemented was often slow: the AUT commented that "Often Vice Chancellors will say to us that they would love to operate in terms of the agreement which they had made in good faith but the funding councils have not provided them with the money to enable them to do so" (Q182). It is, however, expected that such a concordat will be agreed very shortly[1].

INTERACTION BETWEEN ACADEMIA AND INDUSTRY

4.22 Better interaction between industry and academia was considered desirable because it would improve the career prospects of contract research staff while at the same time benefiting both academia and industry through closer mutual understanding and the input of fresh ideas (p354). The Department of Trade and Industry pointed out in the 1995 Competitiveness White Paper[2] that "maintaining and improving the strength of research in our higher education institutes is vital to national competitiveness"[3]. Similar opinions have already been expressed in many earlier enquiries undertaken by this Committee[4].

4.23 It was stated that in the past there had been little positive interaction between academia and industry, and that there were two cultures which often felt little need to interact or integrate[5]. On the academic side, the culture was very attractive to those who were stimulated by their research: Sir John Cadogan, Director-General of the Research Councils, noted that "We must never underestimate the allure and seduction of being able to pursue things that you think are important to pursue. That freedom, of course, is not there in industry" (Q118). Some felt that this cultural gap still existed, and that "a change in prevailing culture would be likely to stimulate mobility to a greater extent than new or modified special schemes" (p322[1]). According to the European Commission "The proportion of research scientists and engineers in the business sector is lowest in Europe (52 per cent) compared to the US (75 per cent) and Japan (69 per cent)" (p289), and Unilever said that many newly-recruited British scientists at PhD level were less proficient than equivalent US or European scientists in their awareness of the commercial environment (p357).

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[1] On 20 July, the day after the agreement of the Committee's report, the CVCP sent a draft concordat to Vice-Chancellors and Principals. This concordat was agreed between the Research Councils, the Royal Society, the CVCP and other bodies. The relevant parties hope to endorse a final version of this concordat by the end of 1995.

[2] *Competitiveness: Forging Ahead*, HMSO, May 1995 (Cm 2867).

[3] Ibid., paragraph 11.31.

[4] See, for example, *Proposed Science and Technology White Paper*, HL Paper 34, session 1992-93; and *International Investment in UK Science*, HL Paper 36, session 1993-94.

[5] See pp274, 286, 291, 348.

4.24 There were, however, notable improvements: Sir John Cadogan said "the thing that certainly has struck me and has encouraged me is how strongly universities...are trying to get connected to industry" (Q117), and such movement was noted elsewhere[2]. In some subjects, such as chemistry and biochemistry, there were strong links with the relevant industries, namely the chemical (p286) and pharmaceutical industries, with the ABPI suggesting that "there is no need to try to improve movement from academia to industry - the present policies are working well and will continue provided the economy is healthy and industry is thriving" (p149). There were numerous sandwich students and students on industrial bursaries (Q75), who were "sought after by industrial research managers" and considered to be "head and shoulders above the conventional undergraduate graduating from a traditional course" (Q734[3])[4]. Arrangements for visiting professors from industry were increasing in universities, although one witness[5] commented "departments have not really learned how to use visiting professors properly" (Q40). Particular departments in some universities had developed strategic alliances with companies (p291), in which companies sponsored chairs and lectureships, or provided financial support to centres of excellence or institutes[6]. Some universities were beginning to set up industrial consultancies, a practice common already in the United States, which "enormously improves the transfer of knowledge between industry and universities" (p355[7]). Finally, Government schemes such as the Teaching Company Scheme[8], LINK, ROPA awards[9] and the Senior Academics in Industry Scheme[10] were considered to be of great help in developing industry-academia links[11]. However, appreciation of the LINK scheme was reflected in places by a concern that it was being scaled down: the Royal Society of Edinburgh believed "the curtailment of this scheme will be counter-productive for industry-academia understanding" (p172).

4.25 Some of the above improvements had come about as a result of the decline of in-company research facilities and the consequent need to "out-source" industrial research[12]. This worried some witnesses[13].

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[1] Professor John Andrews, Chief Executive of the HEFCW.

[2] See for example Q39.

[3] ABPI.

[4] See also Q727.

[5] Professor F W Bullock, UCL.

[6] See p311 for an example of such an alliance, the Glaxo Institute for Applied Pharmacology at the University of Cambridge.

[7] School of Electrical Engineering and Computer Science, Queen's University of Belfast.

[8] The Teaching Company Scheme was introduced in 1975 to provide high quality company-based postgraduate training for engineers akin to that received by doctors in teaching hospitals. Since then it has developed (see pp298-299) and the Department of Trade and Industry stated that it "is widely acknowledged as being one of the most effective mechanisms available for improving academic-industry mobility and has been replicated in several overseas countries" (p298).

[9] The acronym *ROPA* stands for *Realising Our Potential Awards*, which are named after the title of the 1993 science white paper.

[10] See p299.

[11] See pp76, 172, 291, 310; QQ423, 1059-1060.

[12] This was not only the case in the United Kingdom but in the United States also: IBM and Bell Laboratories were as susceptible to downsizing their research facilities as were BT, GEC, and other research-intensive companies.

[13] See pp229, 294.

4.26 Despite the improvements, there was still much to be done to optimise the level of interaction. Industry-academia links were felt to be strongest in large, research-based companies and in universities with strong historical connections with local industries, notably the former polytechnics. Small and medium sized enterprises were often unaware of the benefits of academic assistance[1]. As Professor Tom Blundell, Chief Executive of the BBSRC noted (with regard to his Research Council's speciality),

> "In the science-intensive industries, the pharmaceutical industry, the biotechnology industry, the agro-chemical industry and the chemical industry they have a very good perception of the importance of scientifically trained staff. But in many small and medium sized enterprises - for example in the food industry - there are very few post-doctorals employed" (Q586).

Dr D Grant, Director of Technology at GEC, pointed to another problem when he noted "There is a problem for academics who work with industry, caused by the HEFC's Research Assessment criteria. In essence, a researcher and the department of his or her university often gain no recognition for helping industry and would rather spend their time producing papers for learned journals. These papers are judged to be of higher importance to many individuals and departments than working with industry" (p304). The Institute of Physics, Glaxo and COSHEP pointed to a need to establish industry-academia links at undergraduate level[2]. Finally, salary differentials between industry and universities were felt to be so high as to discourage industrialists from going into academia: the CVCP felt that "universities are rarely able to recruit at the salary level necessary to attract industrial scientists into industry" (Q40)[3]. As a result of all these factors, there were suggestions that those universities which promoted industry links should be rewarded by the research councils (p318).

4.27 It was suggested to the Committee, especially during its visit to the United States, that industry-academia relations would improve as universities became more aware of the need and potential for revenue from intellectual property rights. The ABPI believed that "A shortage of funds, together with more realistic views on overheads and the management of intellectual property, has made industrial co-operation more interesting, at least for enlightened departments" (p149). Furthermore, as Sir Geoffrey Allen pointed out, salary differentials might narrow since "the emphasis on the exploitation of research means that an increasing number of academic scientists have incomes from patents or industrial activities" (p274).

4.28 Some witnesses drew attention to problems concerning pensions. Sir Geoffrey Allen said that "the only obvious improvements that can be made by legislation to the mobility of scientists between academy and industry is to ensure full portability of pensions" (p275).

WOMEN IN SCIENCE

4.29 There was a particular interest among witnesses on matters concerning women in science, with some devoting the major part of their submissions to issues under this heading. This concern about women in science followed the publication of *The Rising Tide*[4] report by the Committee on Women in Science, Engineering and Technology appointed by the Chancellor of the Duchy of Lancaster in 1993, which had identified actions to advance science, engineering and technology by making better use of the talents of women and to enable women more fully to realise their potential, and the Government's response to that report[5].

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[1] See p187.

[2] See pp140, 305; Q1010.

[3] See also pp116, 198, 274-5, 286, p291.

[4] *The Rising Tide: a report on Women in Science, Engineering and Technology*; HMSO, 1994.

[5] *Women in Science, Engineering and Technology*: Government response to *The Rising Tide: Women in Science, Engineering and Technology*, HMSO,1994.

4.30 Witnesses agreed that there had been considerable progress in the general situation of women in science[1], but that this progress had not been the same in all sectors of university employment. The numbers of women in university positions had improved noticeably over the last two decades, but women had been far less successful at gaining established positions than short term contracts[2]. Progress in certain subjects was commented on favourably, but in some sciences women were still vastly outnumbered[3]. At undergraduate level, the number of women was often equal to that of men in some disciplines (p91)[4]. However women were greatly under-represented at higher levels of seniority: women professors were still a tiny minority even in such subjects as biology where there had traditionally always been a strong female presence (p86), as were women Fellows of the Royal Society (p87). Even so, it was remarked that there was evidence of "improvement, which might lead to an expectation that the next decade might see a substantial change in the profile of women in science" (p91).

4.31 In some areas the system of short term contracts was said to help women. It was recognised that "The expansion of contract research in recent years has increased women's opportunities" (p86[5]) and that "there is some evidence that women scientists with family commitments find the university contract research sector an environment allowing them more flexibility to meet their dual requirements" (p329[6]). Those who had to move when their husband moved jobs were less inclined to seek established posts.

4.32 There was, however, concern that the system of short term contracts in research made it harder for women to enter scientific careers. It was said that the insecurity of contract research in general had acted as a barrier to greater numbers of women embarking on scientific careers and also caused some to drop out of science once they had completed their first degree or at the post-doctoral stage (p85). Moreover, other factors acted against them: maternity leave provisions, it was claimed, were not always fully granted or properly structured and child care facilities were not widespread[7], especially in departments or universities with very few women[8], and although the situation here was improving[9] some considered that tax breaks for child care should be implemented (Q489). Sometimes these facilities were granted to established staff but not to contract workers[10], although the University of Oxford was praised for its attempts to ensure that women contract research staff did not suffer from this fate (QQ206-207). The system of imposing age limits on research contractors often acted against women who had taken career breaks: Dr Nancy Lane stated "one should take, not chronological age, but academic age into consideration. This would be helpful for women because if they took maternity leave for several years then that loss of time would be disregarded" (Q467), and the Royal Society said that "it should become normal practice, when defining criteria for appointments or funding, to think in terms of career stage...as well as age" (p241)[11].

4.33 There were other factors. Cultural attitudes played a significant part[12], with some noting the need for an effort to combat the popular perception of science as being more for men than for women[13] and the Wellcome Trust noting that "many women claimed difficulty in being taken seriously in a male-dominated profession" (p50); however, some argued that a change in attitude was well under way (p4). This perception was blamed on school teaching (at all levels but particularly post-GCSE)[1]; on parental attitudes (p272); on the relative scarcity of role models for women scientists[2]; on the trend away from single sex education both at secondary and tertiary levels[3]; and on the (sometimes unintentional) attitude of some male scientists. The combined effect of these factors was that women often lacked self-confidence when applying for positions[4] or returning from a career break (p165) and tended to be less assertive than men (p315).

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[1] See pp67, 91, 166, 214-5, 322; QQ49, 430.

[2] See pp327, 329.

[3] See pp86, 91, 214, 286, 323, 329, 354; Q524.

[4] See also Q430.

[5] Dr Joan Mason.

[6] Dr E A Johnson.

[7] See pp85, 173, 363; Q462.

[8] See pp2, 90, 274.

[9] See QQ129, 418.

[10] See p39; Q130.

[11] See also p294.

[12] See pp86, 166, 187; Q1052.

[13] See pp91, 93.

4.34 Witnesses spoke favourably of schemes which had been initiated to encourage women either to take up scientific careers or to draw them back into science after career breaks, which could often have a bad effect on future careers[5]: ICI noted "Since academic careers are significantly based on reputation, a loss of several years places those wishing to re-enter at a disadvantage" (p323). Three schemes were mentioned in particular: the Daphne Jackson Memorial Fellowships Trust Scheme[6], the Springboard Scheme[7], and the (now defunct) Open University Women Returners' Scheme[8]. Re-training after career breaks was seen as essential for those who wished to keep up with scientific developments[9]. It was also hoped that more women could be encouraged back into their careers after career breaks by the spread of part-time posts[10] and job-sharing schemes (p150).

4.35 On general prospects for the future, many witnesses were optimistic that women would continue to increase their representation in science[11] and the European Commission pointed out that "over the last decade, women's graduation rates have grown considerably faster, by 86 per cent in the case of Engineering and Technology compared to 26 per cent for men, showing that trends are improving" (p290). However, there was anxiety lest those in positions of authority assume that the situation would improve without any further positive action to make careers for women in science more attractive[12]: for, as Dr Anne Wright noted, "It can be tempting to assume that the increasing uptake by girls and women will continue despite any negative or counter initiatives, that it is for some reason historically inevitable" (p90). However, there was hostility towards positive discrimination towards women[13]. There was general agreement on the need for monitoring the situation[14], and the Government's decision to establish a Development Unit for Women in Science at the OST was welcomed (Q467).

THE MRES

4.36 There were mixed opinions on the proposed MRes degree. Generally speaking, it was less favoured by the chemical and pharmaceutical industries (which believed themselves to have been well served by the PhD system)[15] than by the engineering industry (p291).

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[1] See pp223, 272, 292, 354, 366; Q911.

[2] See pp187, 288; Q477.

[3] See pp93, 231; QQ459, 914, 1053.

[4] See QQ458, 508.

[5] The Committee were told in America that women who took time out of their careers to start families were regarded by some senior scientists as not being serious enough about their careers.

[6] See pp88, 150, 287; QQ48, 506. The most comprehensive account of the Daphne Jackson Memorial Trust Scheme is given in the second part of the evidence by Dr E A Johnson, the scheme's Co-ordinator (pp331-334).

[7] See p86, Q508.

[8] See pp88, 109; QQ490-498.

[9] See pp50, 165; Q763.

[10] See pp50, 67, 346.

[11] See pp4, 90, 275, 356.

[12] See p93, Q430.

[13] See pp306, 367; Q961.

[14] See p90; Q527.

[15] See pp291, 253c; Q140. It should, however, be noted that the Royal Society of Chemistry has been sufficiently concerned about the state of PhDs in Chemistry to produce a report on the issue (*The chemistry PhD: the enhancement of its quality*, Royal Society of Chemistry, April 1995). One should also guard against the temptation to believe that particular disciplines or industries were unanimous in their support for or opposition to the MRes: as Professor Richard Brook, Chief Executive of EPSRC, noted, "chemistry on the whole was not persuaded, but I have met individual chemists who have told me that it is an excellent idea" (Q404).

4.37 As for universities, while there was much caution as to whether the degree would be worthwhile, with the CVCP noting the variation in support for the proposal throughout the university sector (Q60), there were many applications from departments to host pilot schemes (Q142) and some universities, such as UCL (p4), were enthusiastic about the degree, believing that there would be no difficulty in attracting high quality applicants (Q65).

4.38 The advantages of the MRes were seen as the grounding of scientists in research skills and in skills essential outside science. AEA Technology considered that it would raise the standard of postgraduate research students and regretted that the OST and the Research Councils were proceeding cautiously (p272), and others believed it would allow students to examine their aptitude for research in general and academic research in particular before they undertook a PhD. Professor Howard Newby felt that it would "provide a student with a further degree of research training which will enhance their employment prospects in a wider world than academia" (Q1268). Many witnesses accepted the need for better, more versatile, research training: the Department of Health, for example, believed "better criteria are needed to select prospective PhD students" (p297), even though it did not fully endorse the MRes, and the CBI thought "one possible role for the MRes could be to provide basic research training for individuals who subsequently wish to pursue a PhD whilst based in a business research environment" (p292)[1].

4.39 Opposition to the MRes focussed on doubts as to its necessity[2]. The University of Leeds, for example, stated that "The MRes highlighted the need for training in generic skills for research students and that is beneficial. However, as an end in itself the MRes is a "stand alone" qualification and does not appear to be needed by many employers" (p274). The Council of Science and Technology Institutes regarded it as "totally unnecessary" (Q1109). It was hoped by some that the MRes would not be used as a screening procedure or pre-requisite for PhD candidates[3] or would be used as an excuse to cut back on the number of PhD students or to shift funding from other areas of postgraduate education[4]. Some felt that it would not be of as much value as other degrees such as the MSc or the MPhys[5] and that those who completed MRes degrees without proceeding to PhDs might be seen as either failed PhD students or those who had chosen to waste a year[6]. NERC worried that higher education "might primarily view the MRes as simply an additional potential entry source and pre-qualification for the PhD rather than a genuine dual objective scheme also serving the diverse sectoral and generic needs of industrial employment" (p67).

4.40 However, some preferred to reserve their judgment until the results of the pilot scheme could be seen, or were satisfied by the limited nature of the initial scheme (p286). The University of Edinburgh noted that it had been pleasantly surprised by the quality of the applicants for the MRes pilot scheme that it was hosting (Q962). It was hoped by some that industry would play a positive role in the courses' development so that those who undertook the degree could be suited to industrial careers[7].

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[1] For other expressions of support for the MRes, see pp67, 312-13, 347; QQ215, 509, 736, 1257.

[2] See Q705.

[3] See pp117, 283, 291, 298.

[4] See pp4, 173; Q66.

[5] See pp141, 294, 298.

[6] See pp49, 151, 274, 281, 298, 306; Q1268. For other expressions of opposition to the MRes, see pp49, 198-9, 215, 243, 348, 355, 367.

[7] See pp187, 330.

CHAPTER 5 OPINION OF THE COMMITTEE

5.1 During this enquiry, the Committee has come across various causes for concern, upon which we remark in this chapter. However, before we record our recommendations, the causes of how the current situation has arisen must be reviewed.

The probable continuation of the current system

5.2 We recognise that the current system of academic research careers has many advantages, which are not confined to one or two of the interested parties at the expense of the other parties. For the universities, the current system allows opportunities to increase their income in a time of financial stringency because, in England and Wales, money for teaching is not quality-related and the best chance of attracting greater income from the HEFCE and HEFCW is to achieve higher scores in research assessment exercises, which in turn means securing funds for high quality research and often the employment of more contract researchers. For the HEFCs, formula funding allows them to manage the financing of a very large university system while at the same time providing a defence against fairly distributed mediocrity and aiding the preservation of a number of research-led universities of international standing. Research councils value being able to sponsor research in universities for two reasons: the first of these is that it is in universities that many innovative concepts are developed, and the second is that this research has the added advantage of permitting the research councils to make some financial savings over performing the research in their own institutes. In this they are similar to industries, charities and government departments, all of which value not only the work itself but also the maintenance of links with high quality scientists in high quality institutions. Finally, the contract staff themselves benefit from the additional opportunity to undertake research in what is a familiar and, despite certain disadvantages, a generally agreeable environment. By such means many young contract researchers are establishing a reputation as good researchers, still a necessary pre-requisite to an established post in a primarily research-led university. For these reasons we consider that contract research is likely to be a significant activity in such universities in the foreseeable future.

5.3 The system has significant defects, however, and those must be removed if the system is to continue. The major defect is that contract researchers in the sciences, now approximately as numerous as established staff in these disciplines, are relatively disadvantaged in terms of career progression, salary, continuity of work, access to facilities available to established staff and participation in the affairs of the university which employs them. Factors such as these and others listed in the proceeding chapter militate against increasing the contribution which contract researchers are capable of making. Furthermore, the perception by others of this group as almost an underclass can only be a deterrent to able young students in science. In the following paragraphs we consider how this situation may be ameliorated.

Making the best of a valuable resource

5.4 University contract researchers in experimental subjects are as numerous as established staff in those disciplines and, together with graduate students, they collectively do significantly more of the actual practical research than the established staff (who have other major duties in teaching and administration as well as research). Established and contract staff have complementary roles and each is indispensable to the other. Moreover we fully accept the argument that many contract researchers have academic qualifications and experience which in earlier times would have been sufficient to secure an established post. We consider that such contract staff should have the same status and rights as established colleagues of equivalent rank. They should be entitled to participate, where appropriate, in university policy and decision making machinery and to have access to the same amenities and facilities as are available to established staff. Only by such changes can the maximum commitment of contract researchers to their university be secured and a valuable sense of collegiality pervade all graduate staff.

5.5 According to many witnesses the conditions under which contract researchers work at present rarely approach this standard and we now turn firstly to some improvements which universities could adopt at little, if any, financial cost, such as career management and smoother transition between contracts; and secondly to the implications which some of our findings have for other aspects of university teaching and research in science.

The need for better career management

5.6 It is apparent to the Committee that scientists who accept contract research posts have much less chance of securing an established post than was the case, say, fifteen to twenty years ago. The CVCP, in their submission to the Committee, made their recognition of this clear in the starkest of terms by stating

> "The number of research staff employed on fixed term contracts is so great, and the turnover in staff holding permanent academic posts so low, that the assumption that an individual will move from a fixed term to a permanent contract is now true in only a small minority of cases" (p1).

This being the case it is essential that the universities as the employers of contract staff have a sound policy for the management of this valuable human resource. Individual contract research staff should have their work regularly assessed and their potential as university teachers and researchers periodically appraised and the findings made clear to them. The locus for these judgments must be the academic department in which the contract researcher works. However, if these judgments indicate that further counselling and career advice is necessary, the contract researcher should have unfettered access to the services which the university provides for these purposes. In our view there is a clear duty on the university to make known to each contract researcher whether or not he or she has a realistic chance of an established university post as soon as that becomes clear and in no case must he or she be left in ignorance of his or her prospects beyond his or her sixth year of post-doctoral work.

5.7 In this context it is necessary to point out that certain contract research scientists may well continue as contract researchers to retirement. These include what may be described as very high grade graduate research assistants whose mastery of new and complicated experimental techniques is essential to modern research.

5.8 Furthermore if contract researchers are to give of their best they must be able to devote all their energies to their research freed from uncertainties that they may be faced with periods of unemployment between contracts or forced to dissipate their energies in the last months of an existing contract by seeking another temporary position. Much can be done to ameliorate the situation if universities earmark funds to ensure that disruptive short gaps and associated demoralising uncertainties of this kind are prevented for the most able staff whom universities wish to retain. After all, this is standard good employment practice commonly followed by private research consultancy firms.

5.9 Very short term contracts have little appeal for the most able. If universities wish to fill vacancies in established posts with high quality individuals in five to ten years' time when these positions should be more abundant they would be wise to create longer-term (eg five year) prestigious fellowships now. The attraction of these has been demonstrated by the high numbers of high quality applicants to the Royal Society, Wellcome Trust and University of Warwick schemes.

Has the present situation any deterrent effect?

5.10 More than 20,000 contract researchers, most of whom work under conditions inferior to those of established members of academic staff and some of whose future prospects as researchers and/or teachers are poor, hardly constitute the best advertisement to attract either able science undergraduates into postgraduate work or school leavers to enrol as university students of these subjects. Several witnesses were concerned about both those deterrent influences, and so is the Committee, because both the quality of the research base and of the research and development carried out by industry in the United Kingdom will be the poorer if there is a failure to secure very able recruits, and *ipso facto* if the standard of entrants to undergraduate and postgraduate degree courses deteriorates. Achievement of the aims of "wealth creation" and "enhancement of the quality of life" will then be deferred. For these reasons we comment on courses at both undergraduate and postgraduate level in universities.

Undergraduate and postgraduate courses

5.11 One of the features of United Kingdom undergraduate courses in science is the quality and inspiration which they are said to offer. It is also claimed, with much truth, that much of the inspiration is generated because the teaching is conducted in an atmosphere of research by staff who are themselves enthusiasts and offer their pupils an attractive invitation to learn and even to research (through undergraduate projects) and so develop critically enquiring attitudes and experience the excitement and rewards of discovery. This regime is ideal for the development of the talents of those who by ability and inclination will succeed in research whether in academia or in industry and therefore be of benefit to their employers.

5.12 There is, however, a down side. The pressure to achieve high ratings in the Research Assessment Exercise which, as we have noted, brings additional money into the departmental coffers, reinforces the natural inclination of established staff to give courses to undergraduates which, by taking them to the boundaries of knowledge and offering an exciting glimpse of research problems, are considered to provide an attractive challenge to the most able students and thereby recruit them as research students. This can result in an over-emphasis on pure research combined with a desire to impress that the courses are collectively more up to date and cover the ground more thoroughly and comprehensively than those of rival university departments. For many academic staff this is seen as an argument for longer (e.g. four-year) undergraduate degree courses, especially as they perceive the A-level courses as being a less adequate preparation than they once were.

5.13 To extend the length of courses is to enhance the cost of producing graduates and in science subjects is misconceived because it is in the nature of advance in understanding of a scientific subject that ever more comprehensive theories continually supersede earlier less comprehensive ideas. The implication is that the courses should not grow in length and that the student should be relieved of the burden of learning redundant notions. As the late Sir Peter Medawar succinctly wrote, "we need no longer to record the fall of every apple".

5.14 Another disadvantage of such subject intensive and extensive courses is that they may well not be those best adapted to develop the latent powers of intellect and personality or give the transferable personal skills they will need to the majority of students who will not have careers in research either in universities or elsewhere. Such students would be better served by their universities through courses where the emphasis is on education *through* rather than *in* science by using science as a means for expanding the general powers of the student's mind - which is the general object of a university education accepted by those responsible for university courses in other areas of knowledge, notably arts and humanities. Graduates of science courses broadened and enriched to satisfy this criterion will be well placed to find employment in competition with those totally unaware of science in a world increasingly dependent on the use of science because they will have a clearer grasp of the power and limits of science in addition to the communication skills commonly regarded as the special attribute of graduates in the humanities.

5.15 The need for courses with broader and more varied subject mixes will undoubtedly grow as higher education expands. They will also be much easier to arrange as more universities modularise courses in all subjects. It is also clear that science undergraduates will need more, and not exclusively scientific, advice on subject and career choice.

5.16 The postgraduate research student, however committed he or she may have been when entering postgraduate study and/or research, is no less in need of guidance, for some discover this is not their metier. They often discover other talents which they could and would prefer to exploit in other spheres of employment but find it difficult to reorient themselves. This is where "conversion" and perhaps other taught courses could have a place and where careers advisory services could play a larger role.

Pensions

5.17 Understandably, pension rights are of some concern to some contract researchers. We consider it to be in the interests of the employer to secure better pension arrangements and advice.

Academia and industry

5.18 Relations between universities and industry have undoubtedly improved in recent years. The latest survey by the CBI[1] shows a marked year-on-year increase of collaboration between industry and academics in research and development which outstrips that of industry with other partners. Moreover, industry expects that this growth will continue and the attitude of academics is also more positive. But more still remains to be done if the optimum scientific symbiosis is to be achieved. The Committee is keen to stress the value of academic and industrial scientists spending significant time working in each other's environment. We should like to see effective mechanisms whereby small and medium sized enterprises can benefit, for example by universities creating consultancies which will make more widely known what they can offer and by taking a leading role in "clubs" for science-based industry in their areas so that, in the words of the Technology Foresight Steering Group, they become "local foci for business change". In this context it is clear that beneficial changes would be catalysed if funding councils would reward successful initiatives in their financial allocations to universities. We also hope that government sponsored schemes such as the Teaching Company Scheme and the Senior Academics into Industry Scheme, both of which are proved facilitators of good industry-academia relations, will be enlarged in scope. The LINK scheme is equally valuable and for that reason we cannot understand why the money allocated in 1994-95 was less in real terms than that in the preceding year. The newly established ROPA awards have certainly been and are likely to continue to be a spur to universities to institute more schemes for knowledge transfer for the benefit of industry. However it seems to us to be an unjustified pre-emption of Research Council procedures that they must accept support of this scheme as a first charge on their resources. We have no evidence on the numbers or quality of research assistants recruited under this scheme but we judge that its development and its impact on other research council activities should be monitored carefully.

Women in science

5.19 It is clear that academic science does not have its maximum potential participation of women, even if it is far less dominated by men than it has ever been. What is not clear is the degree to which women have been impeded from scientific careers by structural or attitudinal barriers. There is some truth in the view that, given time, women will become more prominent in science than they are now, but that is no justification for stepping down the effort to remove barriers for women scientists.

5.20 As the Committee understands the situation, such barriers are no longer dominated by outdated male attitudes towards having women in science, although these attitudes undoubtedly still persist, largely existing in the softer and less deliberate form which is typified more by a lack of understanding of the pressures of motherhood than in the obviously chauvinistic form. Instead, the barriers are largely structural, typically involving ambiguous maternity provisions, lack of child care facilities and disadvantageous requirements of re-entry after absence. It is essential that where structural barriers do exist, methods be found of removing them, and it is the duty of universities, wherever possible, to ensure that women are not discouraged from taking part in academic science by the lack of consideration for their needs.

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[1] *Innovation Trends*, CBI and National Westminster Bank plc technology unit, 1995.

5.21 We hope that, in particular, employers will interpret more flexibly the age related barriers which make return to work after child-birth difficult by taking "academic" age rather than actual age into account.

Master of Research degrees

5.22 At this stage it is too early to comment on whether the Master of Research degree will be successful in its aims, as the pilot schemes have not yet begun. However, some of the principles behind the scheme are sound and some of the content could, with advantage, be a required element of a PhD course. It is a worry that those who will undertake the degree and cease studies at that point might be prematurely labelled as "failed PhDs", as the intention of the scheme was not to serve as the first year of a three- or four-year PhD but to train scientists in skills essential not only to PhDs but to other post-graduate pursuits. We hope that the MRes will be judged on its true merits and defects, and not on this perception.

5.23 It is understandable that there is a degree of opposition in some quarters to the degree. Much of the chemical industry, for example, has been well served by the existing arrangements and boasts comparatively excellent relations with academia, and sees no need to change the *status quo*. However, the emphasis for the MRes has come about as a result of the whole scientific picture, where it is apparent that many scientists lack the skills which the MRes hopes to introduce. If the MRes can introduce these skills and fulfil the aims noted in the Science White Paper, it deserves to become a part of the academic landscape.

5.24 We welcome the pilot scheme, but it is important that the MRes should not become a compulsory step in any discipline until the benefits of the degree are clear. It is to be hoped that, if the pilot scheme is successful, it will spread organically rather than become imposed on unwilling parties.

5.25 Some of the features of the MRes could be incorporated into undergraduate degrees. We hope that this option is considered carefully.

A final word

5.26 The rapid growth of the number of contract researchers in science employed by British universities (see Chapter 3) under conditions which have attracted considerable adverse criticism can be regarded as maladroit administration of a valuable, highly trained, human resource. It is certainly true that many universities allowed rapid growth in the number of contract researchers without recognising the disadvantageous management implications and taking remedial action. The Committee's view is, however, that, while such criticisms are valid, the universities did not deliberately set out to create a scientific underclass but that that was the result of the preoccupation of the universities with reacting to a financial environment which has been in constant change over almost two decades. The major external pressures were that in this period units of resource have declined very considerably and that, although the numbers of students have greatly increased, the real terms increase in income available to meet teaching costs in universities has not risen at the same rate. As a result, universities have been unable to increase *established* staff numbers and have, by and large, restricted new appointments to replacements for those staff retiring. Consequently student/established staff ratios have increased markedly in all subjects: a change which, in official parlance, is euphemistically called an "efficiency gain". In this situation universities have, quite understandably, sought to increase income from other sources, principally by increasing research work of high quality because this alone, when highly rated in the research assessment exercises, attracts significant increments to the block grant awarded by the funding councils. The success of many universities in this has been noticeable but it is this success which has helped to maintain the rapid growth in contract staff. In these circumstances the neglect of the conditions of contract staff by some universities, though regrettable, is in some measure understandable, but does not absolve them and the other bodies involved from arriving at better arrangements without delay.

CHAPTER 6 SUMMARY OF RECOMMENDATIONS

6.1 Contract staff should have the same status and rights as established colleagues of equivalent rank, including entitlement to participation, where appropriate, in university policy and decision making machinery and access to the same amenities and facilities as are available to established staff (paragraph 5.4).

6.2 It is essential that universities, as employers of contract staff, have sound policies for the management of such staff, including regular and open assessment and appraisal. Universities should also endeavour to improve counselling, career advice and retraining for contract staff (paragraph 5.6).

6.3 Universities should earmark funds to bridge gaps between contracts for contract staff (paragraph 5.8).

6.4 We encourage universities to create longer term fellowships for the most able scientists, in line with the examples of the Wellcome Trust and the University of Warwick (paragraph 5.9).

6.5 Universities should, in devising curricula for science subjects, pay attention to the need for students to be educated through science to careers which may be unrelated to academia rather than narrowly educating them for the purpose of producing the next generation of academic scientists (paragraph 5.14).

6.6 Better advice should be provided to students regarding careers, and university career services should be encouraged to serve contract staff as well as undergraduates (paragraph 5.16).

6.7 We encourage universities to develop mechanisms for secondments between industry and academia, and we encourage them to pay particular regard to small and medium sized enterprises (paragraph 5.18).

6.8 Funding Councils should increase their emphasis on industry/academia links when allocating grants to universities (paragraph 5.18).

6.9 We recommend the continuation of the Teaching Company Scheme and the Senior Academics into Industry Scheme. We encourage the Government to improve the LINK scheme by devoting further funds and to develop the ROPA scheme by securing further resources (paragraph 5.18).

6.10 It is the universities' responsibility to remove, wherever possible, structural barriers to the employment of women in science by strengthening maternity provisions, child care facilities and retraining programmes (paragraph 5.20).

6.11 Age barriers in the employment of scientists should be interpreted flexibly with regard to those women, or men, who have taken time out of careers for family-related purposes (paragraph 5.21).

6.12 The MRes should not become a compulsory step in all disciplines until the benefits of the degree have been ascertained. If these prove to have elements which could usefully be introduced into certain undergraduate courses we hope that careful consideration will be given to their introduction (paragraphs 5.24-5.25).

APPENDIX 1

Sub-Committee II: Academic Research Careers for Graduate Scientists

The members of Sub-Committee II were:

- L. Craig of Radley
- L. Dainton (Chairman)
- L. Dixon-Smith
- L. Haskel
- B. Hilton of Eggardon
- L. Howie of Troon
- L. Phillips of Ellesmere
- L. Redesdale
- L. Renwick

The Sub-Committee appointed as their Specialist Adviser Dr K Paul Whittingham.

APPENDIX 2

List of Witnesses

Those marked * gave oral evidence.

AEA Technology
Dr J Adams, University of Leeds
Sir Geoffrey Allen
* Association of the British Pharmaceutical Industry
Association of Department of Health Funded Research Workers
Association of Graduate Careers Advisory Services
Association of Medical Research Charities
* Association of University Teachers
* Biotechnology and Biological Sciences Research Council
British Postgraduate Medical Federation
Chemical Industries Association
Dr L F Cohen, Imperial College of Science, Technology and Medicine
Commission of the European Communities - DGXII
* Committee of Scottish Higher Education Principals
* Committee of Vice-Chancellors and Principals
Confederation of British Indurstry
Conference of Medical Royal Colleges
* Council of Science and Technology Institutes
Professor R A Cowley FRS, Chairman of Physics, University of Oxford
Dr Christine Davies, University of Glasgow
Department of Health
Department of Trade and Industry
* Engineering and Physical Sciences Research Council
Engineering Professors' Council
Gender and Science, Engineering & Technology Project
General Electric Company
The Geological Society
Glaxo
Dr Susan Greenfield, Department of Pharmacology, University of Oxford
Dr I Hardalupas, Imperial College of Science, Technology and Medicine
Higher Education Funding Council for England
Higher Education Funding Council for Wales
ICI Chemicals and Polymers Ltd, Research and Technology Department
Institute of Biology
Institute of Psychiatry
* Institute of Physics
Institution of Civil Engineers
Dr E A Johnson, Daphne Jackson Memorial Fellowship Trust
Mrs S Knudson
* Dr Nancy Lane
* Dr Joan Mason
Dr Elizabeth McClelland, Palaeomagnetism Laboratory, University of Oxford
Ms Pennie Ottley, University of Central Lancashire
* Medical Research Council
* Natural Environment Research Council
* Professor Howard Newby, Vice-Chancellor, University of Southampton
* Office of Science and Technology
Mrs K M de Reuck
Rolls Royce
* Royal Academy of Engineering
Royal Astronomical Society
Royal College of General Practitioners
* Royal Society
Royal Society of Chemistry
* Royal Society of Edinburgh

Professor J R Sambles, Department of Physics, University of Exeter
* Save British Science Society
Scottish Higher Education Funding Council
Shanks & McEwan (Southern) Ltd
* Professor F J Smith, School of Electrical Engineering and Computer Science, Queen's University of Belfast
Professor M Springford, H H Wills Physics Laboratory, University of Bristol
Unilever plc
* University of Edinburgh
University of Strathclyde
* University of Warwick
* Wellcome Trust
Dr Tom Welton, Department of Chemistry, Imperial College of Science, Technology and Mediciney
Marion J A G Wooldridge
* Dr Anne Wright
Professor K R A Ziebeck, Department of Physics, Loughborough University of Technology

APPENDIX 3

Acronyms

ABPI	Association of the British Pharmaceutical Industry
ACOST	Advisory Council on Science and Technology
AFRC	Agriculture and Food Research Council
AMRC	Association of Medical Research Charities
AUT	Association of University Teachers
BBSRC	Biotechnology and Biological Sciences Research Council
CBI	Confederation of British Industry
CMRC	Conference of Medical Royal Colleges
COSHEP	Committee of Scottish Higher Education Principals
CVCP	Committee of Vice-Chancellors and Principals
EPSRC	Engineering and Physical Sciences Research Council
ESRC	Economic and Social Research Council
EU	European Union
HEFC	Higher Education Funding Council
HEFCE	Higher Education Funding Council for England
HEFCW	Higher Education Funding Council for Wales
MRC	Medical Research Council
MRes	Master of Research degree
NERC	Natural Environment Research Council
OST	Office of Science and Technology
SERC	Science and Engineering Research Council
SHEFC	Sottish Higher Education Funding Council
R&D	Research and Development
RA	Research Assitant
ROPA	Realising our Potential Awards
UCL	University College London

APPENDIX 4

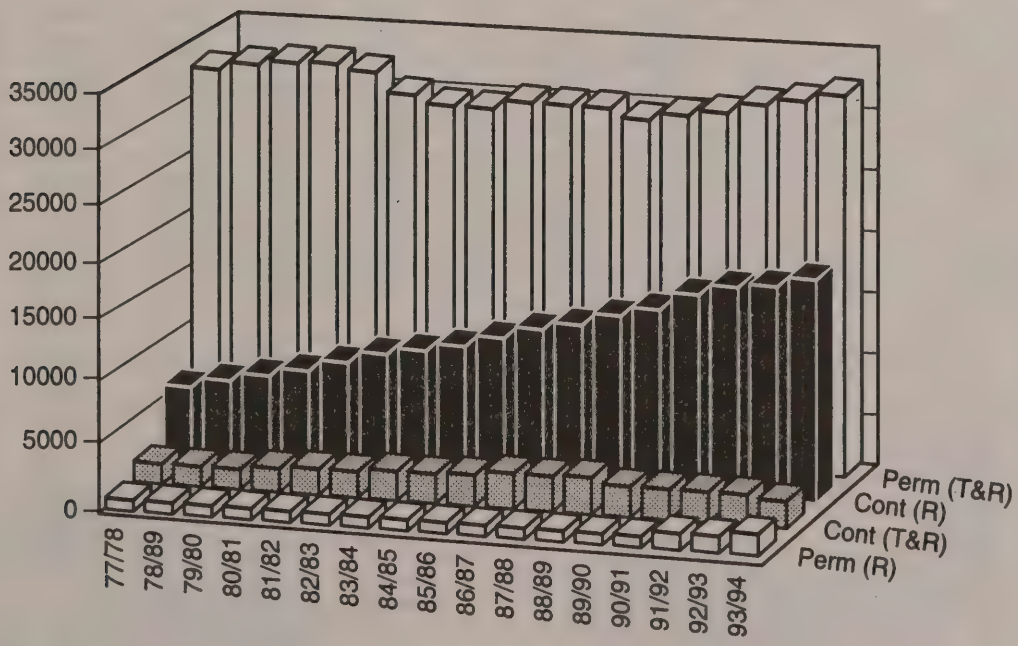
All data relates exclusively to the pre-1992 universities of the higher education sector. They are derived from data either published by or provided separately by Universities' Statistical Record.

1. Academic Staff : Numbers : All UK and all disciplines

	Permanent			Contract			Total
	Teaching & Research	Research only	All	Teaching & Research	Research only	All	
1993/94	32,747	1,750	34,497	2,826	18,627	21,453	55,950
1992/93	32,016	1,431	33,447	3,051	17,646	20,697	54,144
1991/92	31,269	1,369	32,638	3,058	17,355	20,413	53,051
1990/91	30,644	1,217	31,861	2,903	16,497	19,400	51,261
1989/90	30,229	1,111	31,340	2,981	15,069	18,050	49,390
1988/89	29,647	974	30,621	3,402	14,034	17,436	48,057
1987/88	30,240	1,019	31,259	3,167	13,248	16,415	47,674
1986/87	30,381	1,051	31,432	3,075	12,531	15,606	47,038
1985/86	30,386	1,026	31,412	2,874	11,457	14,331	45,743
1984/85	30,065	978	31,043	2,605	10,562	13,167	44,210
1983/84	30,114	982	31,096	2,315	9,738	12,053	43,149
1982/83	30,709	933	31,642	2,097	9,344	11,441	43,083
1981/82	32,688	1,047	33,735	1,973	8,216	10,189	43,924
1980/81	33,212	1,085	34,297	1,895	7,900	9,795	44,092
1979/80	33,173	1,077	34,250	1,848	7,260	9,108	43,358
1978/79	32,664	1,031	33,695	1,714	6,458	8,172	41,867
1977/78	32,023	963	32,986	1,682	5,886	7,568	40,554

The trends are as shown below.

Academic Staff: UK: All Disciplines



2. Academic Staff : Grades and Gender : All Great Britain and all discipline

Permanent Academic Staff: Wholly University Funded

	Professor		Reader & Senior Lecturer		Lecturer		Others		Totals	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
1993/94	5,047	290	8,393	999	13,307	4,133	378	385	27,125	5,807
1992/93	4,788	245	8,281	876	13,232	3,797	352	340	26,653	5,258
1991/92	4,507	211	8,069	780	13,444	3,562	313	340	26,333	4,893
1990/91	4,215	172	7,748	687	13,661	3,321	318	332	25,942	4,512
1989/90	3,996	136	7,600	615	13,980	3,102	280	264	25,856	4,117
1988/89	3,855	113	7,329	550	14,089	2,872	239	230	25,512	3,765
1987/88	3,931	108	7,403	537	14,655	2,715	299	230	26,288	3,590
1986/87	3,854	101	7,213	497	15,106	2,672	322	240	26,495	3,510
1985/86	3,761	97	7,188	480	15,257	2,646	337	224	26,543	3,447
1984/85	3,615	89	7,120	456	15,278	2,542	326	216	26,339	3,303
1983/84	3,684	86	7,397	480	15,526	2,503	279	164	26,886	3,233
1982/83	3,800	91	7,538	494	15,805	2,495	281	154	27,424	3,234
1981/82	4,120	107	7,987	542	16,816	2,628	344	200	29,267	3,477
1980/81	4,147	111	8,011	525	17,177	2,721	383	238	29,718	3,595
1979/80	4,106	111	7,950	518	17,281	2,681	401	236	29,738	3,546
1978/79	4,008	94	7,682	510	17,153	2,585	474	218	29,317	3,407
1977/78	3,963	84	7,410	498	16,969	2,464	447	206	28,789	3,252

Contract Academic Staff : Not - Wholly University Funded

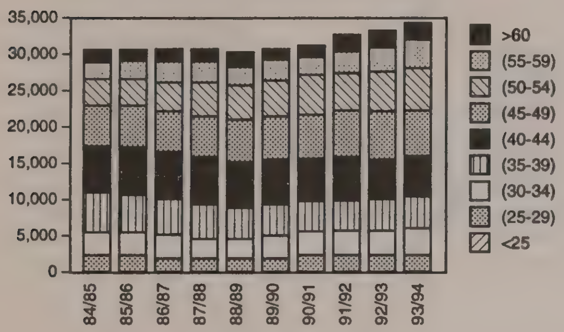
	Professor		Reader & Senior Lecturer		Lecturer		Others		Totals	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
1993/94	437	29	871	260	9,887	4,487	2,926	2,083	14,121	6,859
1992/93	446	35	950	266	9,415	4,030	3,021	2,078	13,832	6,409
1991/92	409	37	904	228	9,170	3,836	3,148	2,163	13,631	6,264
1990/91	394	25	862	227	8,625	3,537	3,156	2,097	13,037	5,886
1989/90	384	23	893	226	7,934	3,118	3,031	2,004	12,242	5,371
1988/89	397	24	1,028	215	7,703	2,896	2,850	1,892	11,978	5,027
1987/88	368	17	998	200	7,314	2,652	2,750	1,701	11,430	4,570
1986/87	345	19	940	170	6,927	2,441	2,789	1,607	11,001	4,237
1985/86	318	12	898	149	6,423	2,139	2,609	1,428	10,248	3,728
1984/85	301	10	796	125	5,900	1,916	2,530	1,280	9,527	3,331
1983/84	239	7	658	94	5,628	1,707	2,396	1,209	8,921	3,017
1982/83	228	5	635	80	5,481	1,543	2,247	1,112	8,591	2,740
1981/82	198	5	56	67	4,763	1,326	2,135	1,030	7,657	2,428
1980/81	192	8	485	61	4,570	1,287	2,053	1,032	7,300	2,388
1979/80	175	6	456	53	4,262	1,165	1,895	988	6,788	2,212
1978/79	174	4	453	47	3,864	986	1,671	875	6,162	1,912
1977/78	174	5	416	45	3,680	858	1,555	744	5,825	1,652

3. Academic Staff : Age Profiles : All UK and all disciplines

3.1 All Permanent Academic Staff

Age Band	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94
<25	240	257	246	230	202	232	266	244	242	259
(25-29)	1,692	1,660	1,603	1,482	1,379	1,606	1,724	1,761	1,782	1,948
(30-34)	3,566	3,506	3,312	3,097	2,982	3,218	3,455	3,613	3,678	3,840
(35-39)	5,888	5,603	5,200	4,694	4,452	4,432	4,470	4,498	4,577	4,672
(40-44)	6,304	6,283	6,333	6,406	6,153	6,075	5,939	5,693	5,364	5,326
(45-49)	5,627	5,811	5,865	5,959	6,060	6,250	6,293	6,491	6,707	6,711
(50-54)	3,735	4,033	4,300	4,599	4,912	5,116	5,190	5,359	5,627	5,810
(55-59)	2,509	2,662	2,833	2,951	2,771	2,807	2,905	3,204	3,603	4,022
>60	1,482	1,597	1,740	1,841	1,710	1,604	1,619	1,775	1,867	1,908
	31,403	31,412	31,432	31,259	30,621	31,340	31,861	32,638	33,447	34,496

Academic Staff Numbers



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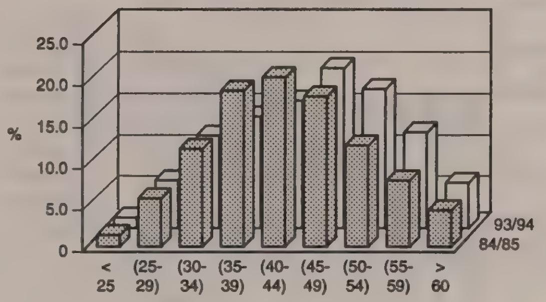
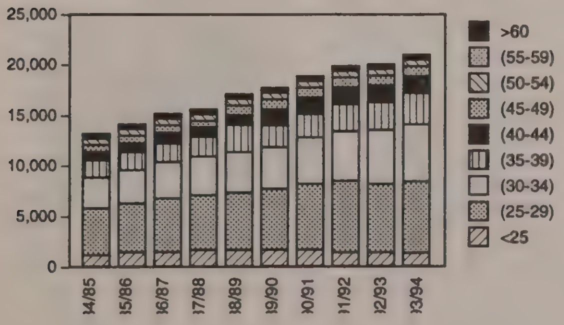


3.2 All Contract Academic Staff

Age Band	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94
<25	1,492	1,646	1,823	1,886	1,819	1,836	1,833	1,718	1,582	1,524
(25-29)	4,524	4,804	5,135	5,312	5,663	5,998	6,493	6,887	6,802	7,009
(30-34)	3,090	3,369	3,737	3,971	4,258	4,427	4,906	5,223	5,544	6,061
(35-39)	1,806	1,987	2,094	2,207	2,345	2,422	2,594	2,866	2,944	3,076
(40-44)	934	1,083	1,274	1,429	1,598	1,592	1,679	1,692	1,681	1,638
(45-49)	536	584	636	696	790	876	965	1,093	1,159	1,141
(50-54)	383	407	418	435	491	450	482	479	528	554
(55-59)	237	259	294	283	289	272	281	289	285	301
>60	165	192	195	196	183	177	167	166	172	150
	13,167	14,331	15,606	16,415	17,436	18,050	19,400	20,413	20,697	21,454

Academic Staff Numbers



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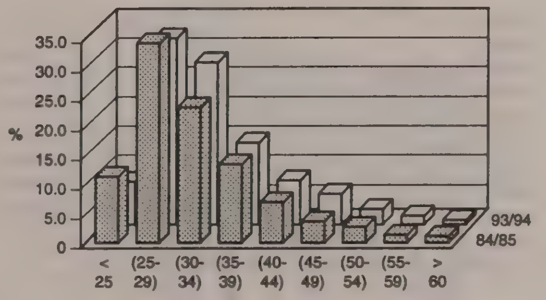
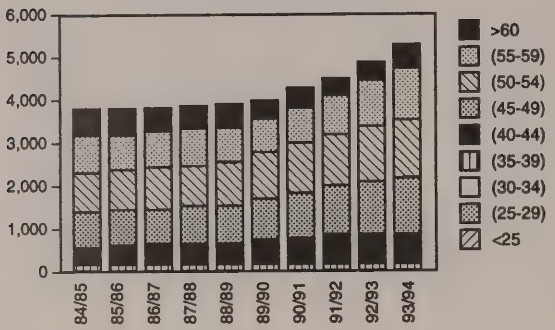


4. Academic Staff : Age Profiles by Grade : All UK and all disciplines

4.1 Permanent Academic Staff : Professors

Age Band	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94
<25	1	1	0	0	0	0	0	0	0	0
(25-29)	1	1	2	1	1	2	1	1	0	0
(30-34)	14	16	14	11	10	16	18	23	16	14
(35-39)	140	155	138	136	151	158	175	177	184	176
(40-44)	439	451	482	500	519	562	595	629	603	648
(45-49)	814	839	856	862	857	940	1,037	1,154	1,273	1,317
(50-54)	891	917	938	981	1,020	1,082	1,157	1,232	1,339	1,406
(55-59)	874	879	903	890	818	845	875	951	1,089	1,223
>60	632	697	736	776	713	652	658	704	721	759
	3,806	3,956	4,069	4,157	4,089	4,257	4,516	4,871	5,225	5,543

Academic Staff Numbers



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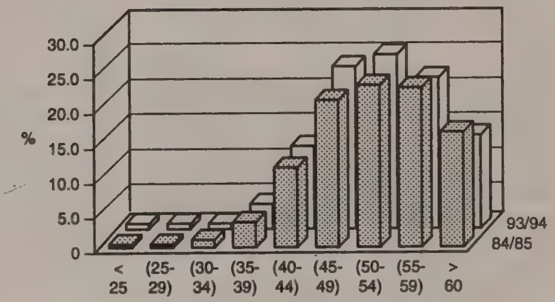
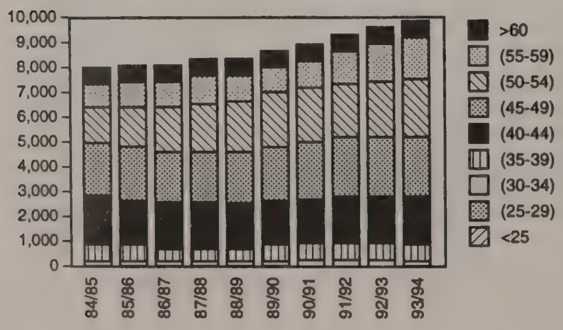


4.2 Permanent Academic Staff : Reader & Senior Lecturer

Age Band	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94
<25	0	0	0	0	0	0	0	0	0	0
(25-29)	1	0	1	2	2	3	2	2	3	3
(30-34)	98	65	84	69	67	93	125	141	133	118
(35-39)	845	771	689	639	643	732	761	818	860	858
(40-44)	1,864	1,812	1,753	1,782	1,711	1,746	1,770	1,806	1,763	1,780
(45-49)	2,179	2,183	2,130	2,152	2,205	2,309	2,359	2,380	2,471	2,450
(50-54)	1,502	1,650	1,773	1,900	2,022	2,107	2,111	2,195	2,277	2,356
(55-59)	930	1,001	1,038	1,134	1,076	1,105	1,184	1,343	1,483	1,657
>60	522	542	603	607	532	517	522	577	652	662
	7,941	8,024	8,071	8,285	8,258	8,612	8,834	9,262	9,642	9,884

Academic Staff Numbers



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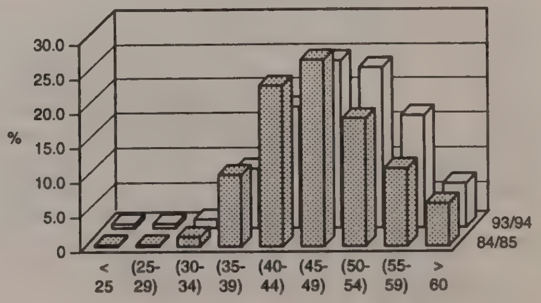
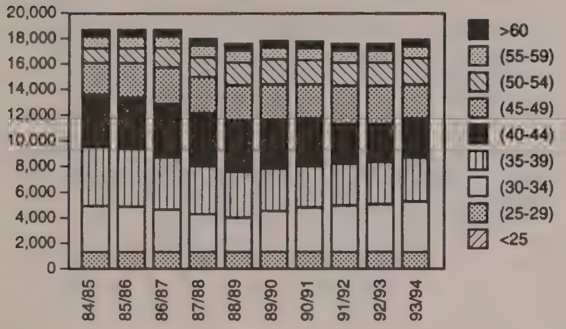


4.3 Permanent Academic Staff : Lecturers

Age Band	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94
<25	111	115	102	105	101	106	111	100	84	102
(25-29)	1,460	1,433	1,372	1,275	1,193	1,388	1,459	1,481	1,482	1,629
(30-34)	3,342	3,325	3,117	2,915	2,806	3,014	3,197	3,337	3,415	3,554
(35-39)	4,859	4,624	4,319	3,867	3,612	3,484	3,478	3,441	3,467	3,571
(40-44)	3,978	3,988	4,064	4,093	3,892	3,728	3,524	3,219	2,961	2,857
(45-49)	2,623	2,776	2,862	2,924	2,973	2,975	2,872	2,924	2,932	2,914
(50-54)	1,337	1,456	1,584	1,706	1,859	1,908	1,895	1,911	1,992	2,032
(55-59)	697	771	885	918	870	851	836	903	1,018	1,130
>60	325	356	395	452	458	430	436	490	488	482
	18,732	18,844	18,700	18,255	17,764	17,884	17,808	17,806	17,839	18,271

Academic Staff Numbers



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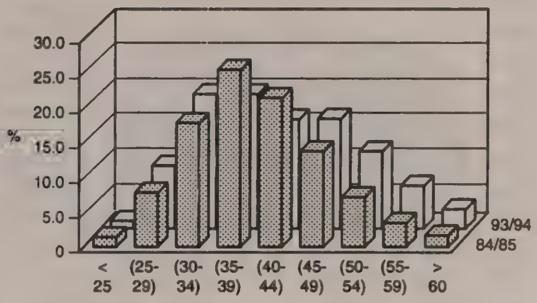
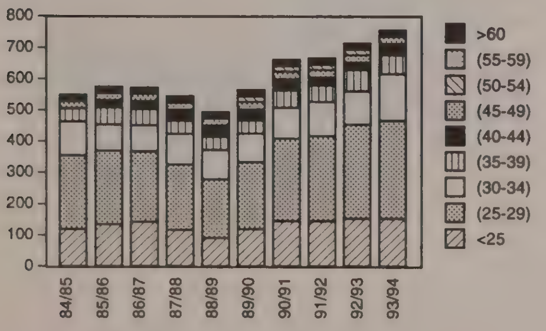


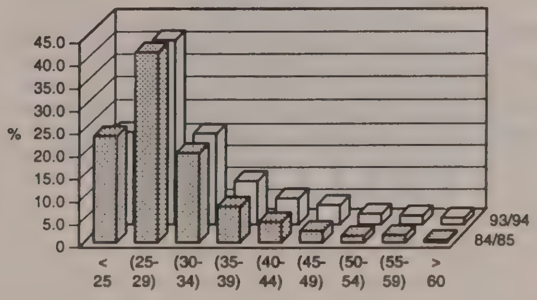
4.4 Permanent Academic Staff : Others

Age Band	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94
<25	125	139	142	124	99	125	152	144	158	153
(25-29)	229	223	223	201	180	207	254	271	293	309
(30-34)	107	97	92	97	93	90	108	108	110	149
(35-39)	42	52	53	48	40	52	52	57	65	66
(40-44)	23	30	31	28	27	35	44	33	35	39
(45-49)	11	13	15	16	20	19	21	31	26	26
(50-54)	5	10	5	11	8	14	20	15	11	10
(55-59)	7	9	6	6	4	6	8	5	10	9
>60	3	1	4	5	5	4	2	4	5	4
	552	574	571	536	476	552	661	668	713	765

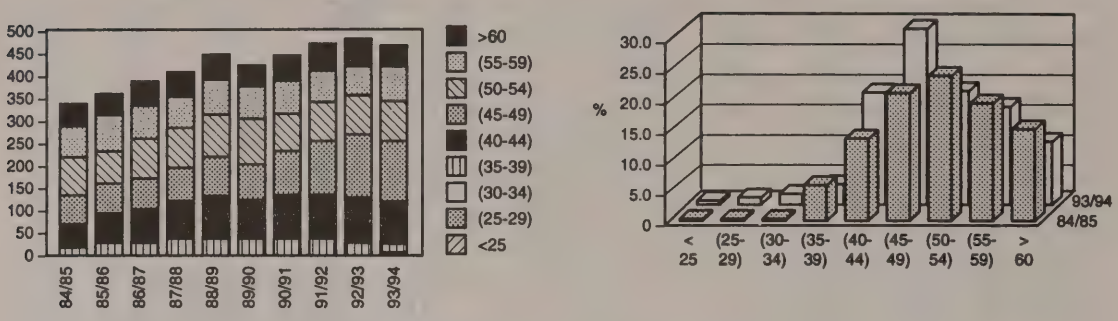
Academic Staff Numbers



As % of Annual Total

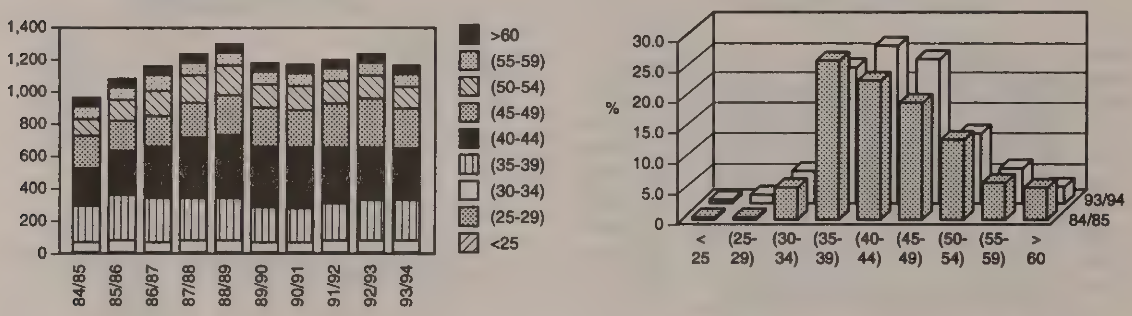


4.5 Contract Academic Staff: Professors


Academic Staff Numbers

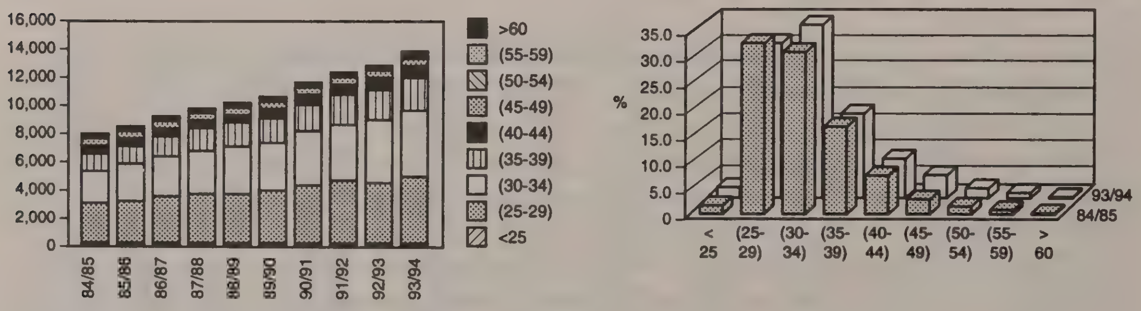
As % of Annual Total

4.6 Contract Academic Staff: Reader & Senior Lecturer


Academic Staff Numbers

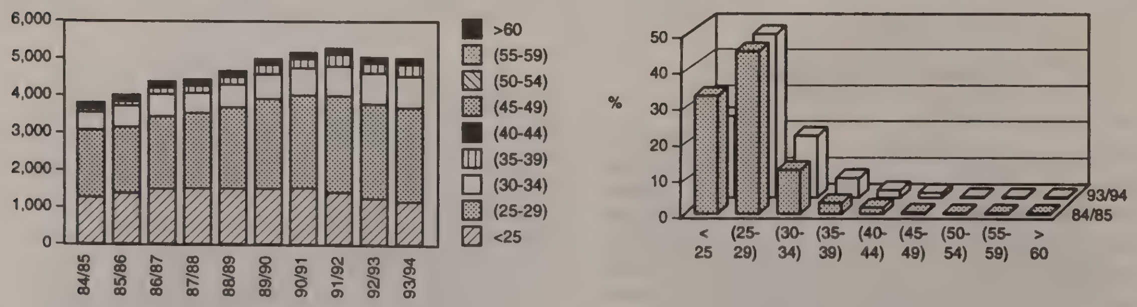
As % of Annual Total

4.5 Contract Academic Staff: Lecturers


Academic Staff Numbers

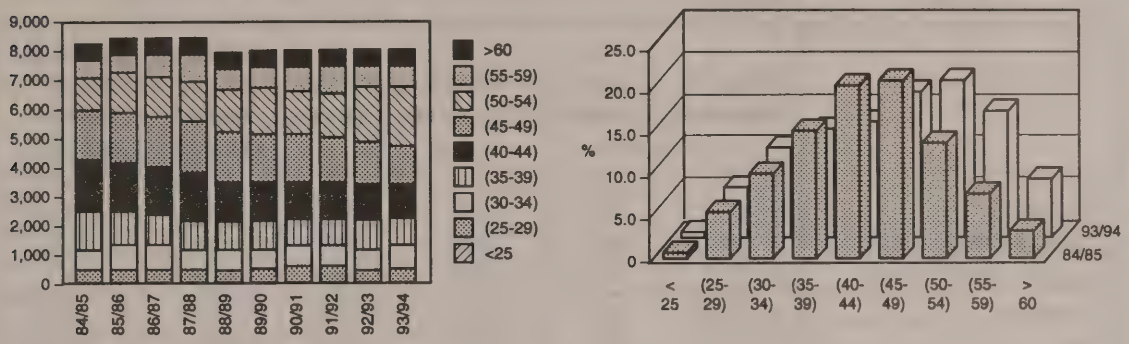
As % of Annual Total

4.5 Contract Academic Staff: Others


Academic Staff Numbers

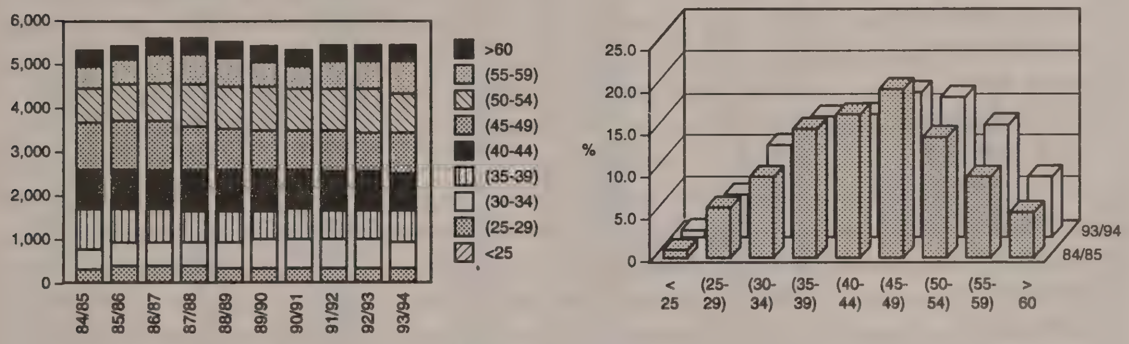
As % of Annual Total

4.9 Permanent Academic Staff: Biology, Mathematics & Physical Sciences


Academic Staff Numbers

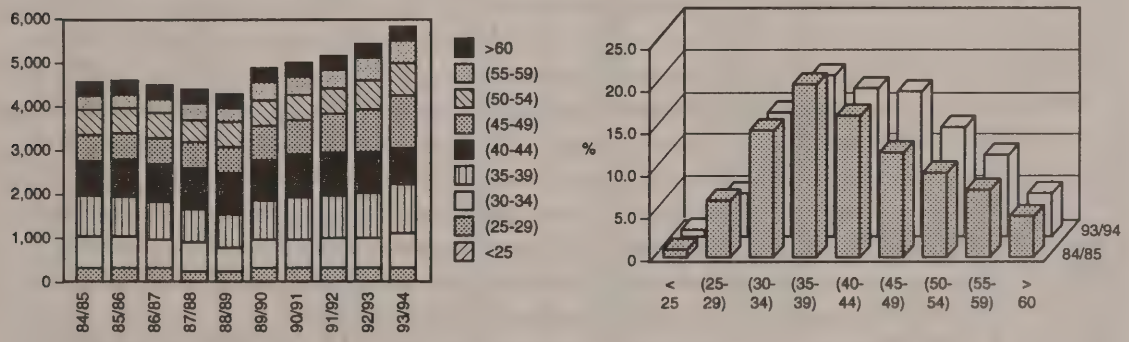
As % of Annual Total

4.10 Permanent Academic Staff: Engineering & Technology


Academic Staff Numbers

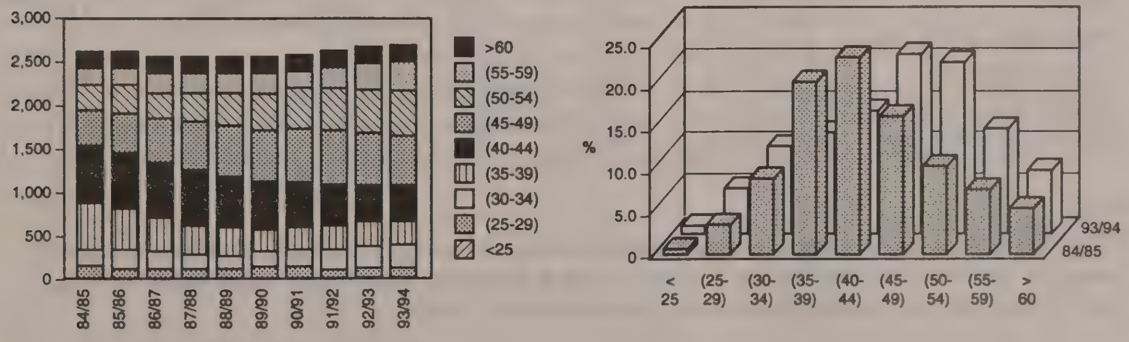
As % of Annual Total

4.11 Permanent Academic Staff: Medicine & Dentistry


Academic Staff Numbers

As % of Annual Total

4.12 Permanent Academic Staff: Other Arts


Academic Staff Numbers

As % of Annual Total

5. Academic Staff : All UK for Academic Year 1992/93 : By Discipline and Gender.

Comparison of the % of staff in each discipline in 1992/1993, by gender and funding status, with the % of women higher degree graduates in 1985/86 and 1992/93

	Men (Permanent)	Men (Contract)	Women (Permanent)	Women (Contract)	% Women Higher Degrees 1985-86	% Women Higher Degrees 1992-93
Nursing	27.1	18.9	72.9	81.1	76	82
Studies Allied to Medicine	54.0	49.7	46.0	50.3	46	57
Language Based Studies	67.1	56.6	32.9	43.4	47	58
Education	67.4	40.7	32.6	59.3	42	56
Law	70.7	57.1	29.3	42.9	32	41
Psychology	76.1	51.1	23.9	48.9	54	67
Veterinary Science	76.4	56.8	23.6	43.2	26	28
Other Social Studies	79.2	57.9	20.8	42.1	38	42
Clinical Medicine	79.5	57.2	20.5	42.8	36	49
Creative Arts	79.8	59.1	20.2	40.9	39	47
Pre-Clinical Studies	79.9	54.0	20.1	46.0	40	45
Clinical Dentistry	81.0	65.1	19.0	34.9	34	43
Business/Management	81.0	64.1	19.0	35.9	23	28
Anatomy & Physiology	81.2	59.5	18.8	40.5	34	50
Planning	82.4	54.5	17.6	45.5	29	40
Humanities	83.6	65.7	16.4	34.3	33	42
Accountancy	83.6	50.0	16.4	50.0	21	32
Pharmacy	84.9	73.4	15.1	26.6	42	52
Pharmacology	86.8	58.3	13.2	41.7	41	43
Other Technologies	87.0	69.1	13.0	30.9	20	13
Geography	87.7	62.3	12.3	37.7	33	37
Other Biological Science	88.2	60.7	11.8	39.3	34	42
Computing	88.4	85.8	11.6	14.2	20	24
Agriculture & Forestry	88.9	71.2	11.1	28.8	25	34
Biochemistry	89.0	62.5	11.0	37.5	34	42
Architecture	90.4	83.9	9.6	16.1	19	38
Other Physical Sciences	92.2	81.3	7.8	18.7	16	26
Mathematics	92.3	82.8	7.7	17.2	22	25
Metallurgy & Materials	93.6	84.7	6.4	15.3	10	19
Chemical Engineering	94.8	79.0	5.2	21.0	12	18
General Engineering	95.5	89.7	4.5	10.3	13	19
Chemistry	95.8	79.1	4.2	20.9	18	27
Physics	96.0	87.5	4.0	12.5	12	15
Mech, Aero & Prod Eng	96.2	88.1	3.8	11.9	3	8
Civil Engineering	96.4	84.5	3.6	15.5	7	14
Electrical & Electronic Eng	97.2	91.5	2.8	8.5	7	8
Minerals Engineering	100.0	85.3	0.0	14.7	6	9

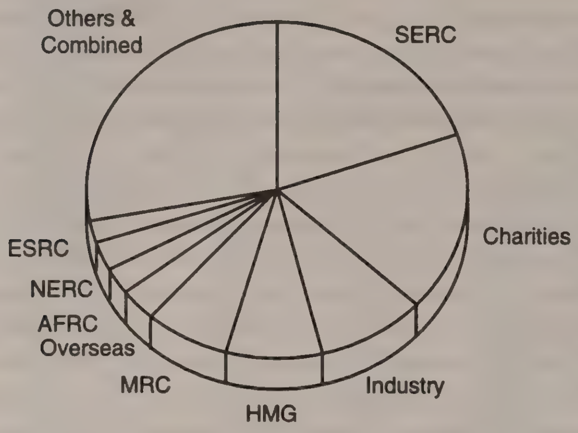
Note:
For all Disciplines, the % of men in permanent academic posts always exceeds the % of men in contract posts. For women, the reverse is true. It is rare for the % of women in permanent posts to approach the value of even the % of women higher degree graduates from 1985/86.

6. Academic staff : All UK (1992/93) : % of Staff in Permanent and Contract Posts : By Discipline

	Permanent	Contract
Biochemistry	35.9	64.1
Pharmacology	38.6	61.4
Clinical Medicine	39.8	60.2
Metallurgy & Materials	41.6	58.4
Minerals Engineering	41.9	58.1
Pre-Clinical Studies	43.8	56.2
Other Biological Science	44.1	55.9
Anatomy & Physiology	45.0	55.0
Physics	48.3	51.7
Chemical Engineering	49.9	50.1
Agriculture & Forestry	51.2	48.8
Veterinary Science	51.8	48.2
Mechanical, Aeronautic & Prod Eng	52.5	47.5
Chemistry	55.1	44.9
Other Technologies	55.1	44.9
Other Physical Sciences	55.1	44.9
General Engineering	55.9	44.1
Electrical & Electronic Engineering	57.1	42.9
Other Studies Allied to Medicine	57.7	42.3
Civil Engineering	61.4	38.6
Pharmacy	61.9	38.1
Computing	62.4	37.6
Psychology	62.5	37.5
Nursing	65.6	34.4
Geography	75.6	24.4
Clinical Dentistry	76.7	23.3
Planning	77.3	22.7
Other Social Studies	77.6	22.4
Architecture	77.9	22.1
Business/ Management Studies	78.6	21.4
Mathematics	80.9	19.1
Education	82.9	17.1
Humanities	88.8	11.2
Law	93.9	6.1
Language Based Studies	95.4	4.6
Creative Arts	95.9	4.1
Accountancy	96.4	3.6

7. Contract Academic Staff : By Who Funds Them : All G B and all disciplines

1993/1994 Academic Year



Men : Contract Academic Staff

Year	AFRC	ESRC	MRC	NERC	SERC	Charities	HMG	Industry	Overseas	Others	Total
1993/1994	331	281	906	382	3,426	2,110	1,161	1,393	446	3,680	14,116
1992/199	310	282	871	392	3,244	1,924	1,185	1,516	349	3,639	13,712
1991/1992	290	292	802	331	3,302	1,766	1,270	1,517	360	3,701	13,631
1990/1991	250	301	816	295	3,239	1,697	1,299	1,550	286	3,304	13,037
1989/1990	208	292	780	242	2,941	1,600	1,360	1,559	278	2,974	12,234
1988/1989	195	232	764	221	2,864	1,484	1,544	1,396	211	3,067	1,978
1987/1988	170	205	729	215	2,981	1,321	2,295	1,218	193	2,103	11,430
1986/1987	187	247	741	205	3,054	1,071	2,380	1,077	157	1,88	11,001

Women : Contract Academic Staff

Year	AFRC	ESRC	MRC	NERC	SERC	Charities	HMG	Industry	Overseas	Others	Total
1993/1994	219	229	679	136	649	1,530	561	531	169	2,145	6,848
1992/1993	217	231	620	131	597	1,356	575	542	103	1,993	6,365
1991/1992	218	243	591	124	585	1,282	601	567	95	1,958	6,264
1990/1991	190	233	586	102	584	1,206	569	556	108	1,752	5,886
1989/1990	147	200	547	91	561	1,077	606	563	95	1,477	5,364
1988/1989	133	153	541	67	563	982	615	502	70	1,401	5,027
1987/1988	114	127	502	60	554	797	901	437	58	1,020	4,570
1986/1987	131	139	488	56	528	652	840	424	55	924	4,237

% Women : Contract Academic Staff

Year	AFRC	ESRC	MRC	NERC	SERC	Charities	HMG	Industry	Overseas	Others	Total
1993/1994	39.8	44.9	42.8	26.3	15.9	42.0	32.6	27.6	27.5	36.8	32.7
1992/1993	41.2	45.0	41.6	25.0	15.5	41.3	32.7	26.3	22.8	35.4	31.7
1991/1992	42.9	45.4	42.4	27.3	15.1	42.1	32.1	27.2	20.9	34.6	31.5
1990/1991	43.2	43.6	41.8	25.7	15.3	41.5	30.5	26.4	27.4	34.7	31.1
1989/1990	41.4	40.7	41.2	27.3	16.0	40.2	30.8	26.5	25.5	33.2	30.5
1988/1989	40.5	39.7	41.5	23.3	16.4	39.8	28.5	26.4	24.9	31.4	29.6
1987/1988	40.1	38.3	40.8	21.8	15.7	37.6	28.2	26.4	23.1	32.7	28.6
1986/1987	41.2	36.0	39.7	21.5	14.7	37.8	26.1	28.2	25.9	32.9	27.8

8. Finances: Pre-1992 Universities

The main streams of money are in the form of exchequer block grants, student fees and money (public and private) for research. Government funded research is managed through two principal agencies, Funding and Research Councils.

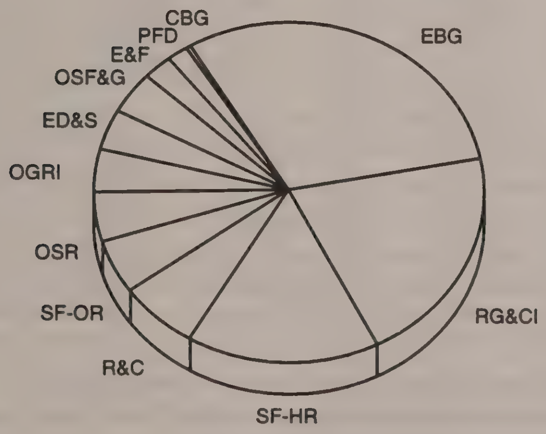
8.1 Income : All UK universities

8.1.1 Full Income Summary : Real Term : 1993/1994 = 100 : £ million.

	1989/1990	1990/1991	1991/1992	1992/1993	1993/1994
Block Grant	2,205	1,811	1,676	1,671	1,780
Equipment and Furniture	150	148	133	143	166
Computer Board Grants	50	48	42	42	15
Student Fees - Home Rates	282	614	840	907	865
Student Fees - Others Rates	248	247	265	285	304
Other Student Fees & Support Grants	158	181	199	218	228
Endowments, Donations & Subventions	164	181	192	210	238
Residences and Catering	326	342	358	378	400
Provision for Depreciation	54	55	60	74	82
Other General Recurrent Income	185	191	207	244	278
Research Grants & Contracts	939	998	1,008	1,140	1,239
Other Services Rendered	208	219	241	260	292
Total UK University Income	4,970	5,036	5,221	5,574	5,888

Note : Throughout the Appendix the GDP Deflator has been used to convert cash to real terms : Source is the 1995 Forward Look.

Pre 1992 University Income: 1993/94



Key

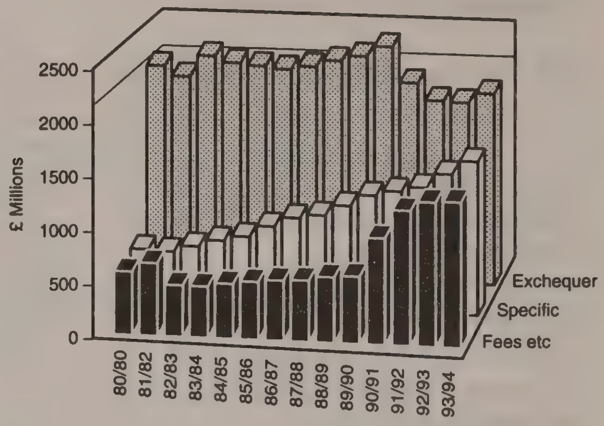
BG = Block Grant
CBG = Computer Board Grants
E,D&S = Endowments, Donations & Subventions
E&F = Equipment & Furniture
OGRI = Other General Recurrent Income
OSF & SG = Other Student Fees & Support Grants
OSR = Other Services Rendered
PfD = Provision for Depreciation
R&C = Residences & Catering
RG&C = Research Grants & Contracts
SF-HR = Student Fees - Home Rates
SF-OR = Student Fees - Others Rates

A major revision in 1989/90 of accounting practice makes direct comparisons with earlier years difficult. However for some broad categories of income it is possible to compare as far back as 1980/81. These are shown below;

8.1.2 Broad Incomes Comparisons : Real Term : 1993/1994 = 100 : £ million.

	Exchequer Grants	Fees & Support Grants	Specific Income
1993/94	1,961	1,397	1,531
1992/93	1,856	1,410	1,401
1991/92	1,852	1,304	1,249
1990/91	2,007	1,043	1,217
1989/90	2,405	687	1,147
1988/89	2,260	637	1,040
1987/88	2,213	610	934
1986/87	2,149	590	883
1985/86	2,125	551	774
1984/85	2,137	517	689
1983/84	2,164	486	626
1982/83	2,224	477	561
1981/82	2,010	679	514
1980/80	2,119	589	502

UK Universities: Broad Income Trends



Exchequer block grant comprises block grant, equipment and furniture and computer grants, fees and support grants are the sum of the three student fee categories and research support grants and specific income comprises research grant and contract income and other services rendered.

8.2 Specific Income :

University income is available in more detail for specific income, which comprises monies from all sources for research grants and contracts and for other (non-research) services rendered.

8.2.1 Research Grant & Contracts income : real term : 1993/1994 =100 : £ million.

Funder	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94
Research Councils	283.6	325.9	325.4	311.8	397.6(*)	436.4(*)
UK Based Charitable Bodies	174.4	192.1	222.8	238.0	256.6	293.6
UK Central Government Bodies	138.6	130.6	142.7	141.1	150.0	153.3
UK Industry	122.5	129.5	131.9	130.7	126.3	131.4
European Union Sources	n/a	47.5	55.6	63.5	83.0	101.9
Other Overseas Sources	80.8	53.0	57.6	57.0	55.8	53.5
Other Sources	40.4	43.4	44.4	43.8	44.7	38.8
Health & Hospital Authorities	n/a	17.1	19.1	22.3	26.4	29.8
Total	840.4	939.0	999.5	1,008.1	1,140.4	1,238.7

n/a = not available separately, included as appropriate in either overseas or other sources totals.
(*) For the Research Councils, the 1992/3 figures onwards include additional dual support transfer money, from Funding to Research Councils.

8.2.2 Other Services Rendered : real term : 1993/1994 =100 : £ million.

Funder	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94
Other Sources	98.7	131.8	135.9	146.3	155.4	162.0
Health & Hospital Authorities	84.7	48.8	45.2	54.1	59.2	80.6
UK Central Government Bodies	14.5	19.4	26.3	21.1	23.5	25.1
European Union Sources	n/a	8.3	11.9	19.1	22.3	24.5
Total	197.9	208.4	219.3	240.6	260.4	292.3

n/a = not available separately, included in other sources total.

8.3 Expenditure By Discipline

Far greater details are provided of the academic department expenditures.

8.3.1 Total Academic Department Expenditures : real term : 1993/1994 = 100 : £ million

Academic Department	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94
Medicine	512.6	550.3	588.0	623.9	657.3	714.4
Other Biological Sciences	186.6	198.2	211.1	209.6	223.5	230.4
Other Social Studies	167.2	175.1	191.6	202.4	209.0	221.6
Physics	159.2	164.9	166.4	161.7	169.2	168.4
Language Based Studies	135.4	144.1	148.2	152.1	157.0	161.8
Chemistry	142.6	150.5	142.4	140.2	145.5	155.8
Business & Man'ment Studies	89.6	99.0	105.7	120.1	127.1	132.6
Elec & Electronic Eng	109.7	115.6	119.8	114.3	125.0	125.6
Mech, Aero & Prod Eng	101.9	103.7	109.3	111.1	111.4	115.5
Education	86.3	93.1	98.8	99.2	107.8	113.5
Humanities	89.9	90.7	96.6	100.8	105.3	110.7
Computer Science	87.9	93.9	97.5	100.5	102.9	105.9
Mathematics	76.2	79.0	81.0	81.6	84.3	86.2
Other Physical Sciences	81.0	79.5	78.1	78.4	82.9	80.7
Biochemistry	69.0	71.5	69.0	70.0	74.1	76.3
Anatomy & Physiology	52.4	54.5	57.4	61.1	64.1	69.5
Civil Engineering	53.5	56.1	58.8	62.2	62.1	65.5
General Engineering	61.5	69.9	57.2	56.9	59.4	64.7
Pre-Clinical Studies	45.1	49.4	51.8	51.8	59.6	61.4
Psychology	45.4	48.1	52.3	55.6	57.8	61.3
Law	37.5	42.2	46.3	49.6	51.6	55.9
Geography	39.8	41.6	44.9	45.8	48.4	50.5
Dentistry	44.6	46.1	46.5	48.0	48.2	50.0
Agriculture & Forestry	34.0	36.2	36.6	45.1	46.8	50.0
Other Technologies	47.8	53.8	47.4	47.1	44.9	46.7
Veterinary Sciences	35.8	37.9	39.8	40.3	43.6	45.1
Chemical Engineering	31.6	33.2	37.1	35.1	38.6	41.7
Nursing	5.1	6.2	7.7	10.7	18.3	40.9
Metallurgy & Materials	32.5	38.4	37.9	38.1	37.6	38.4
Creative Arts	26.4	26.2	27.6	28.0	29.1	30.9
Pharmacology	19.4	20.5	23.7	23.8	24.1	27.5
Pharmacy	22.0	23.4	24.1	25.0	25.8	27.4
Other Medicine Studies	15.2	16.0	17.0	20.3	20.4	24.1
Architecture	15.0	15.5	16.2	16.0	16.9	17.2
Accountancy	11.6	12.2	13.1	13.8	14.8	15.1
Planning	8.9	10.0	11.6	12.9	14.3	13.7
Mineral Engineering	7.7	8.1	7.7	8.5	9.0	8.5
Total	2,787.9	2,954.4	3,065.8	3,161.7	3,317.8	3,505.2

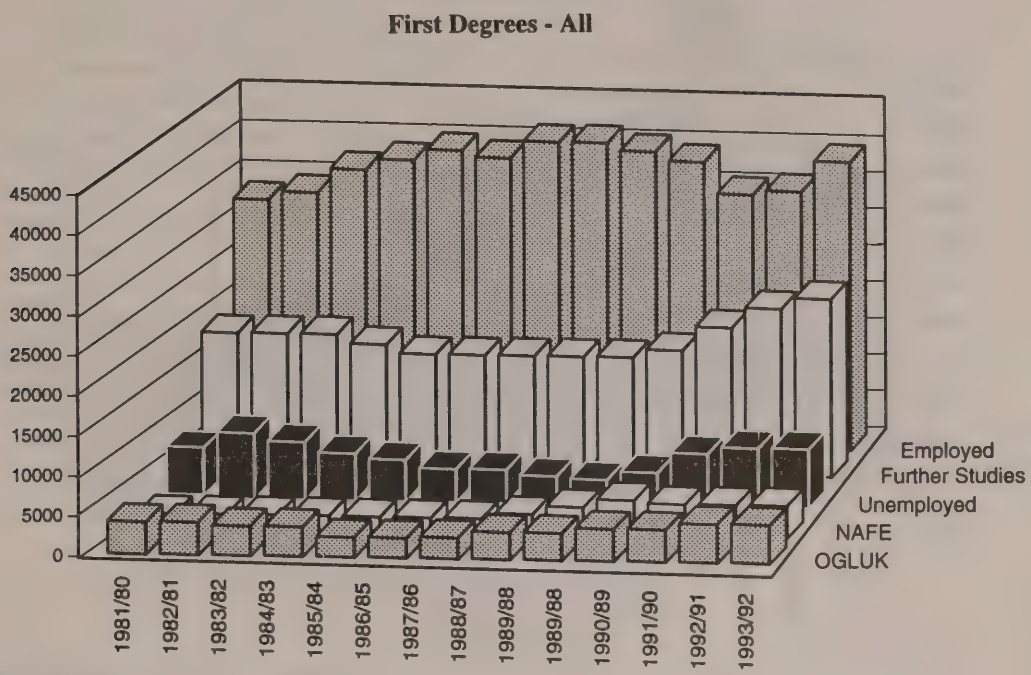
(*) Academic department expenditure covers salaries of academic and academic related staff, other salaries and wages, other general expenditure, equipment, research grant and contract and other services rendered that relates to the activities of the academic department.

8.3.2 Research Grant & Contract Expenditures : real term : 1993/1994 = 100 : £ million

Academic Department	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94
Medicine	215.0	232.9	259.4	267.7	287.8	320.1
Other Biological Sciences	64.3	71.1	83.2	80.7	89.3	94.6
Physics	64.9	69.8	71.0	65.5	72.6	76.1
Chemistry	43.9	50.6	45.6	41.6	46.8	53.4
Other Social Studies	34.5	35.5	38.9	40.0	39.9	43.6
Biochemistry	31.1	33.3	33.9	34.8	36.9	40.0
Elec & Electronic Eng	31.3	35.4	39.0	33.0	38.1	38.8
Mech, Aero & Prod Eng	32.1	32.2	31.3	31.9	32.7	33.8
Anatomy & Physiology	17.7	19.8	21.7	24.9	27.4	31.5
Computer Science	23.2	26.2	25.6	27.3	29.8	30.6
Pre-Clinical Studies	17.8	20.8	22.9	23.8	26.8	28.9
Other Physical Sciences	18.6	22.9	25.4	25.6	27.6	26.1
General Engineering	15.2	19.0	15.3	14.9	16.4	18.9
Metallurgy & Materials	12.2	17.7	16.7	16.7	16.3	17.3
Chemical Engineering	10.2	11.5	13.7	11.1	13.5	15.6
Civil Engineering	11.7	13.7	13.8	14.4	14.7	15.6
Veterinary Sciences	10.4	12.0	13.4	13.6	15.4	15.5
Psychology	12.1	13.5	15.1	15.2	14.2	15.3
Other Technologies	19.7	22.3	14.4	16.2	13.4	14.2
Agriculture & Forestry	9.5	11.2	11.4	12.4	12.8	14.1
Pharmacology	7.4	8.4	11.4	11.6	11.8	13.9
Mathematics	11.4	12.8	14.5	13.6	13.4	13.7
Education	15.5	19.4	21.3	17.1	15.4	13.5
Business & Man'ment Studies	11.8	10.6	11.6	11.9	12.3	13.0
Humanities	7.4	7.2	8.6	9.2	10.0	10.7
Geography	6.3	6.9	8.7	9.0	9.3	9.9
Pharmacy	5.8	6.8	6.7	6.6	7.1	7.8
Dentistry	4.7	4.9	5.0	5.6	6.0	7.4
Other Medicine Studies	4.1	4.5	4.7	7.7	5.7	7.2
Language Based Studies	6.2	9.2	8.2	6.4	5.9	5.0
Mineral Engineering	3.2	3.2	2.6	3.4	3.2	3.3
Nursing	1.4	1.7	2.2	2.2	2.4	2.6
Law	1.1	1.4	1.3	2.7	2.9	2.2
Planning	1.2	1.6	1.9	1.8	2.2	2.2
Architecture	2.1	2.1	1.9	1.8	1.6	1.9
Creative Arts	0.6	0.4	0.5	0.5	0.5	0.6
Accountancy	0.6	0.6	0.6	0.7	0.5	0.6
Total	785.5	873.2	923.4	923.1	982.6	1,059.4

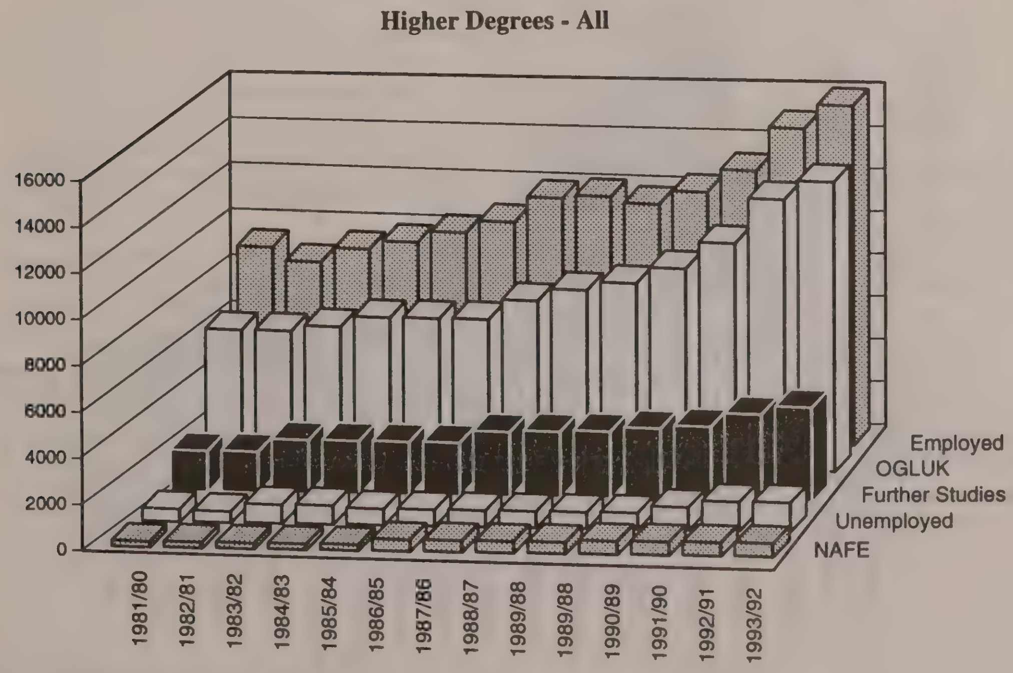
9. University Graduates: Employment

9.1 First Destination of First Degree Graduates



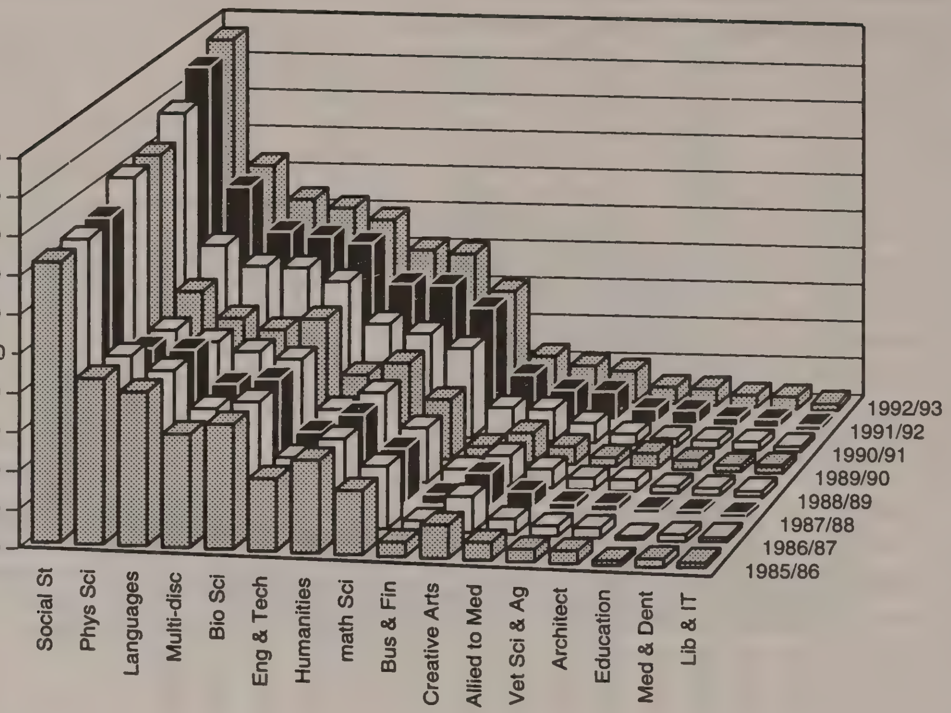
Employment = Sum of all employment categories. OGLUK = Overseas graduates leaving the UK.
NAFE = Not available for further employment.
Further Studies = Research and academic studies, teacher training and law society.

9.2 First Destination of Higher Degree Graduates

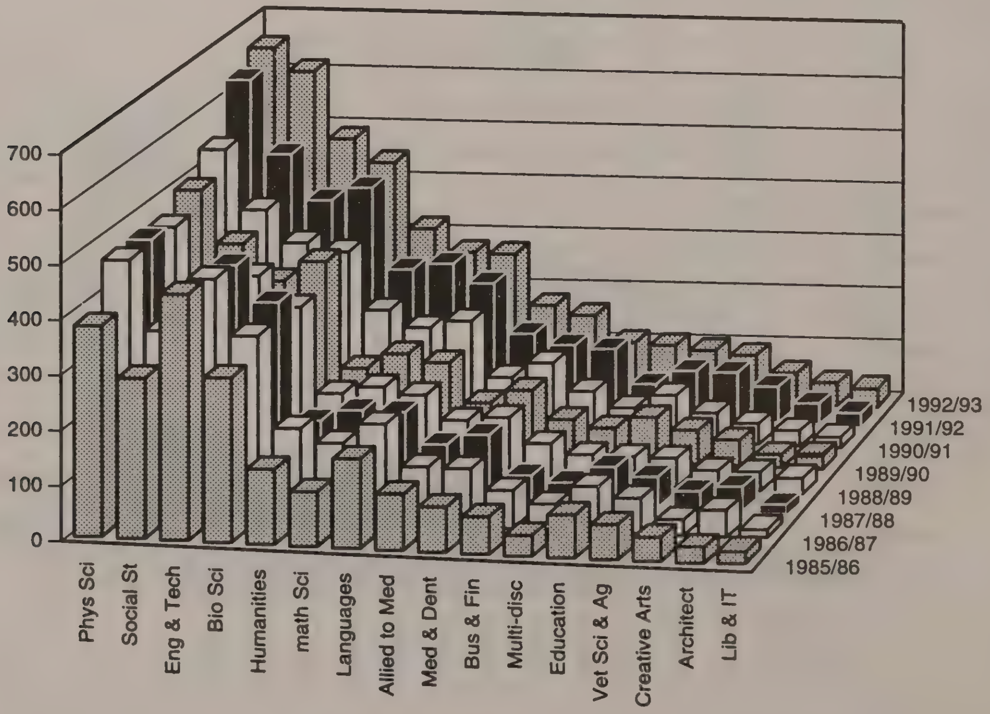


Employment = Sum of all employment categories. OGLUK = Overseas graduates leaving the UK.
NAFE = Not available for further employment.
Further Studies = Research and academic studies, teacher training and law society.

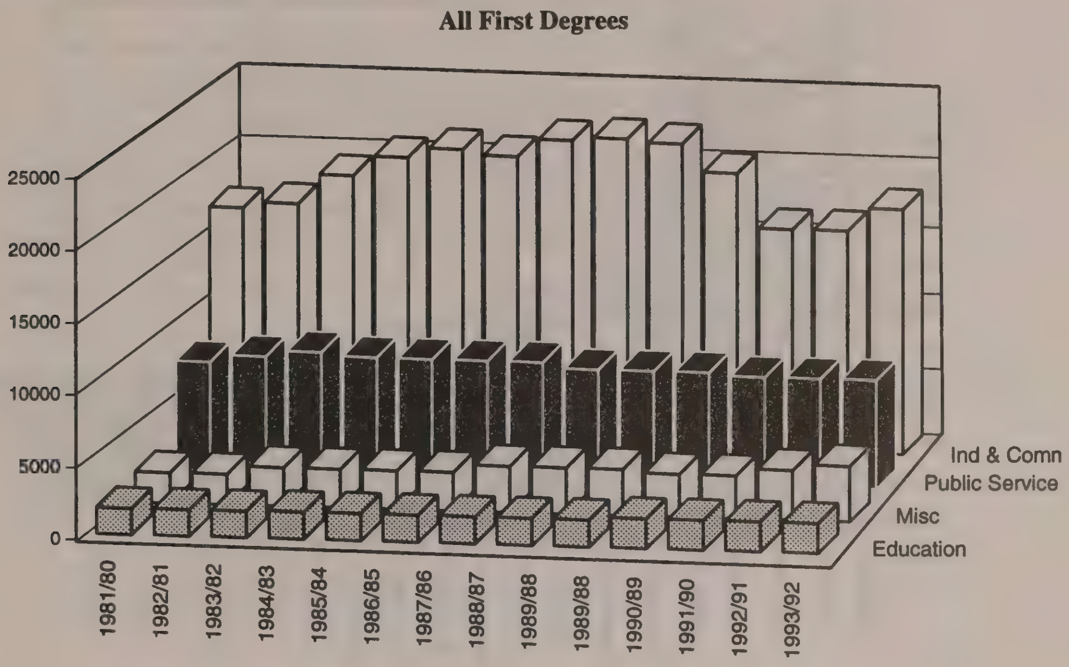
9.3 First Degree Graduates - Undertaking Further Studies



9.4 Higher Degree Graduates - Undertaking Further Studies

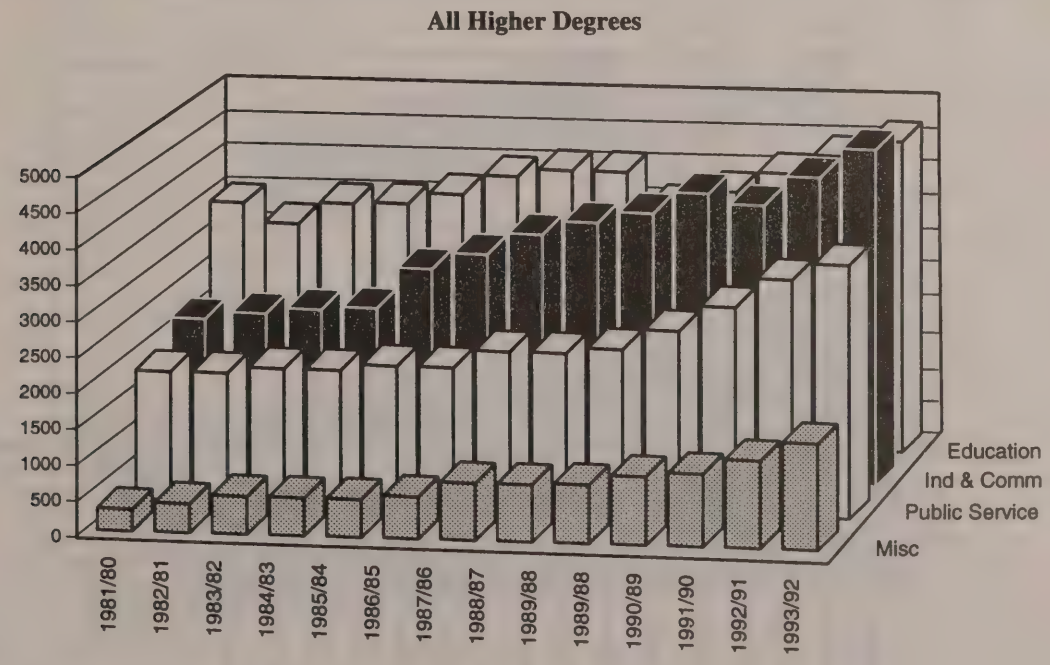


9.5 Employer Category of First Degree Graduates (who entered Permanent Home employment)



Industry & Commerce covers 9 broad business sectors.
Public Service = Local & Public Authorities, HM Forces and Civil Service and Central Government Bodies.
Education = Schools, Technical & FE Colleges, Polytechnic & Central Institutes & Universities.

9.6 Employer Category of Higher Degree Graduates (who entered Permanent Home employment)



Industry & Commerce covers 9 broad business sectors.
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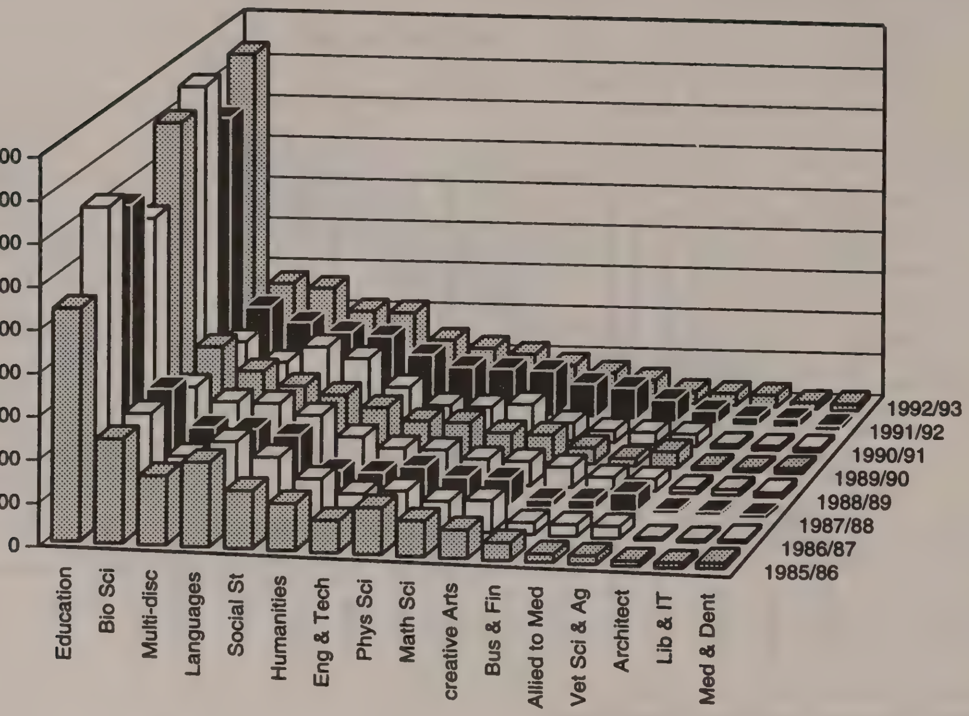
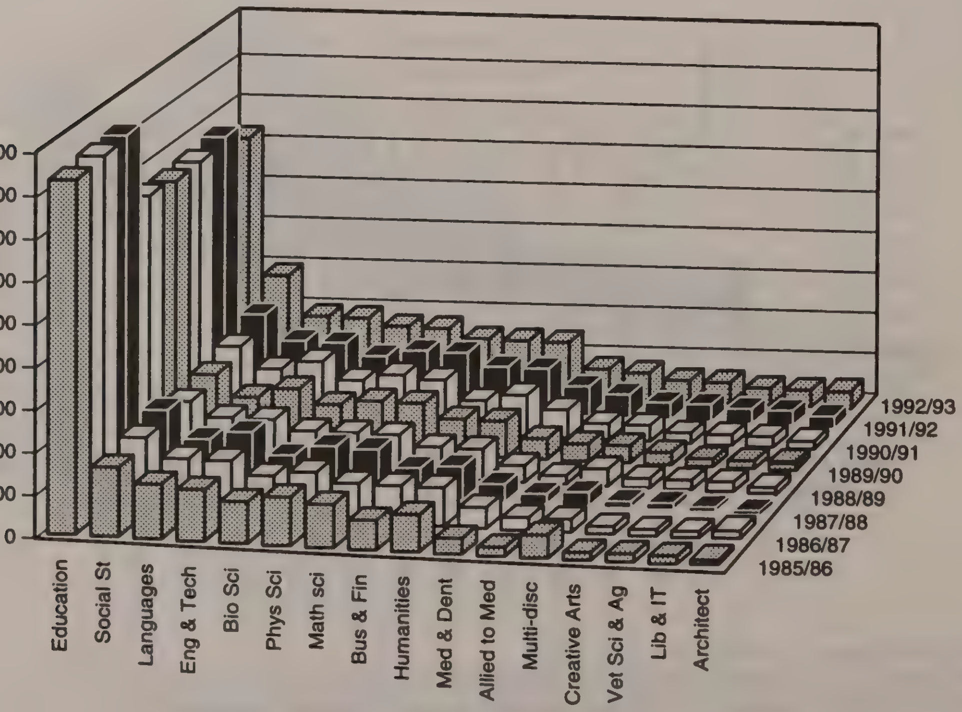
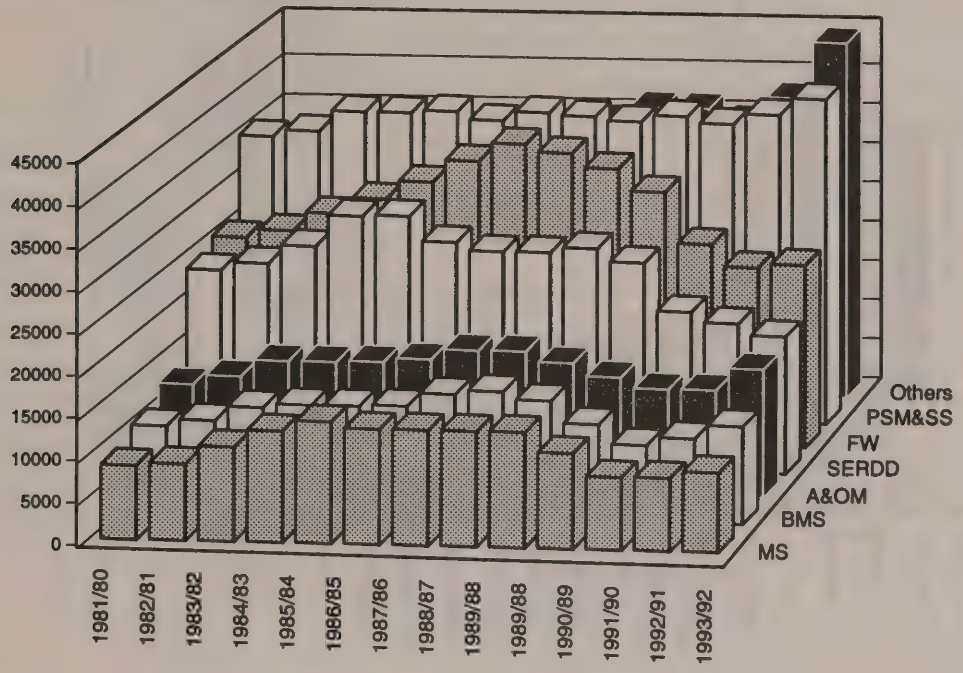
9.7 First Degree Graduates going to Education Related Employment



9.8 Higher Degree Graduates going to Education Related Employment

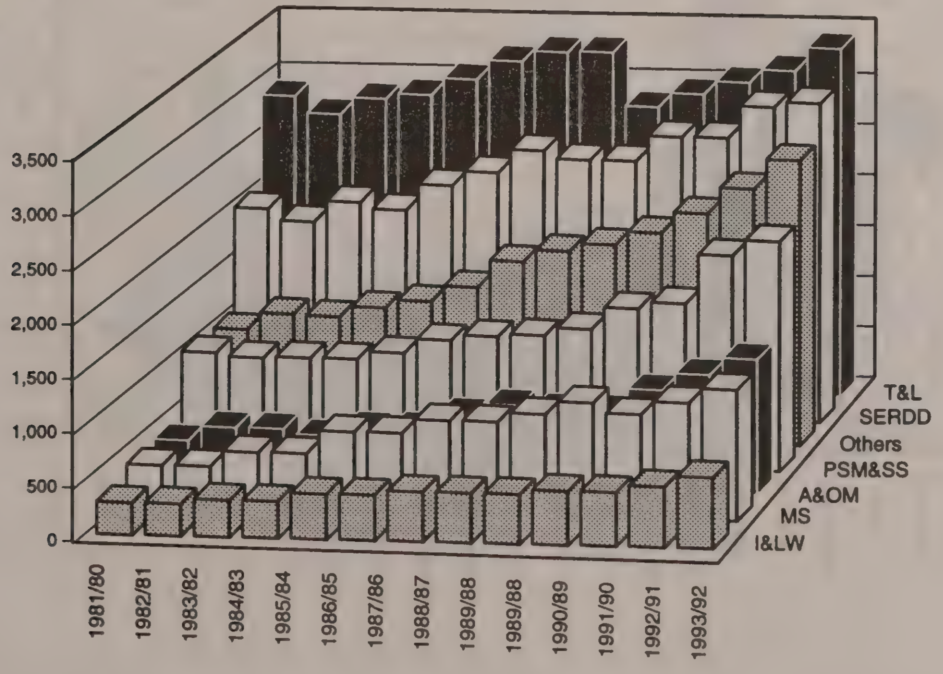


9.9 Type of Work for First Degree Graduates (who entered Permanent Home Employment)



PSM&SS = Personel, Social, Medical & Security Services
SERDD = Scientific/Engineering Research, Design & Development.
BMS = Buying, Marketing & selling.
Others = Next 6 biggest work type categories + miscellaneous.
FW = Financial Work.
A&OM = Administration & Operational Management.
MS = Management Services.

9.10 Type of Work for Higher Degree Graduates (who entered Permanent Home Employment)



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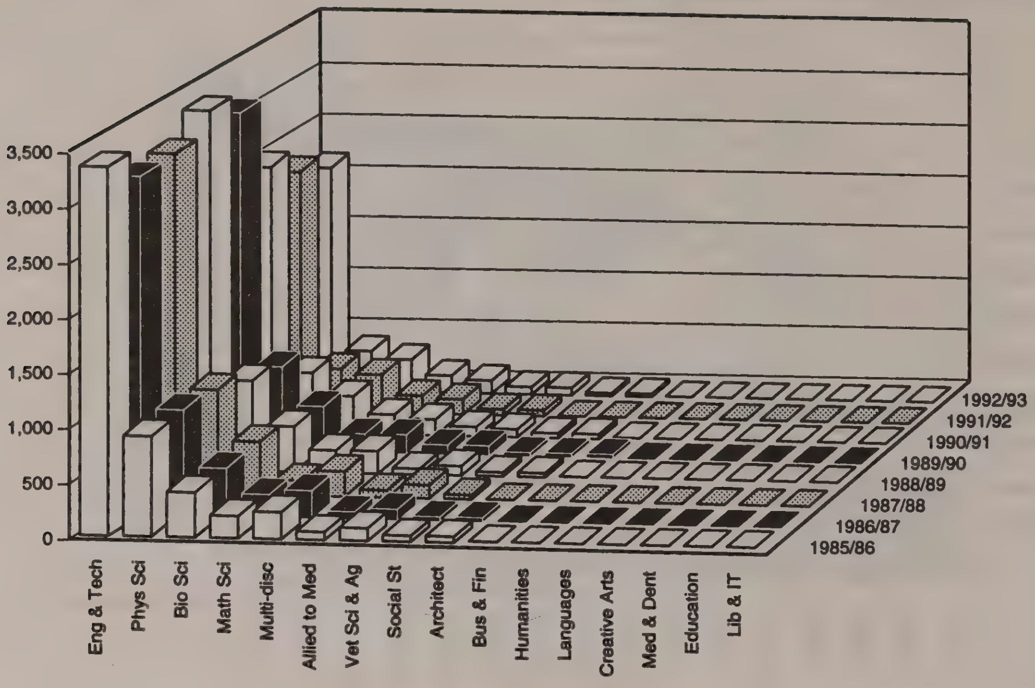
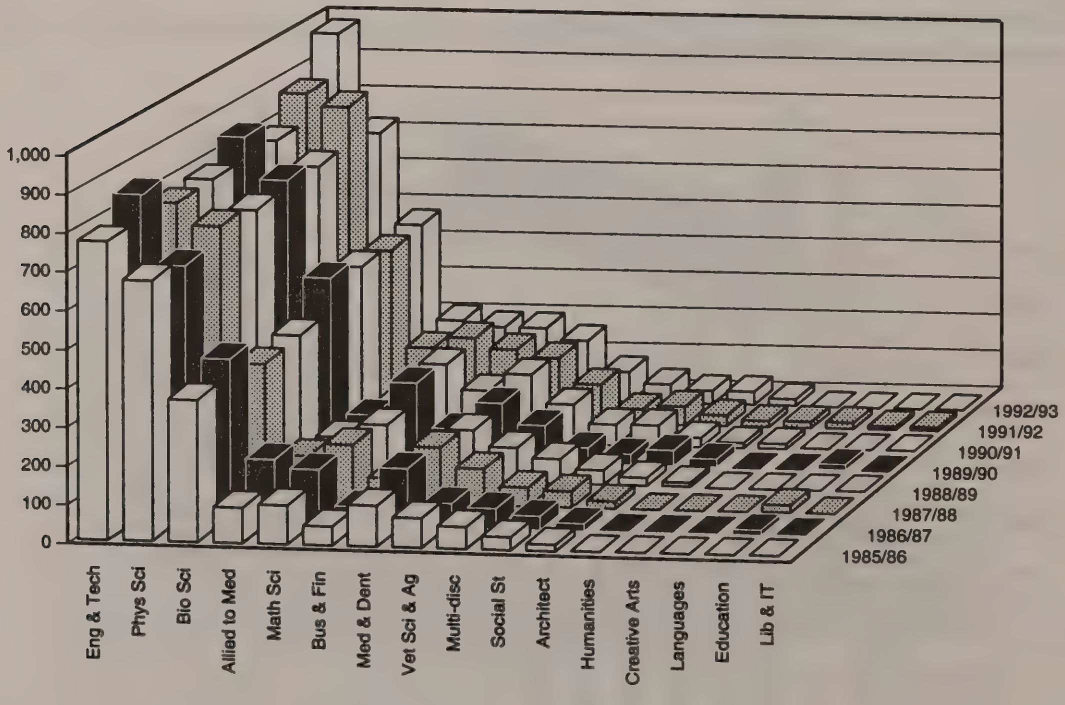
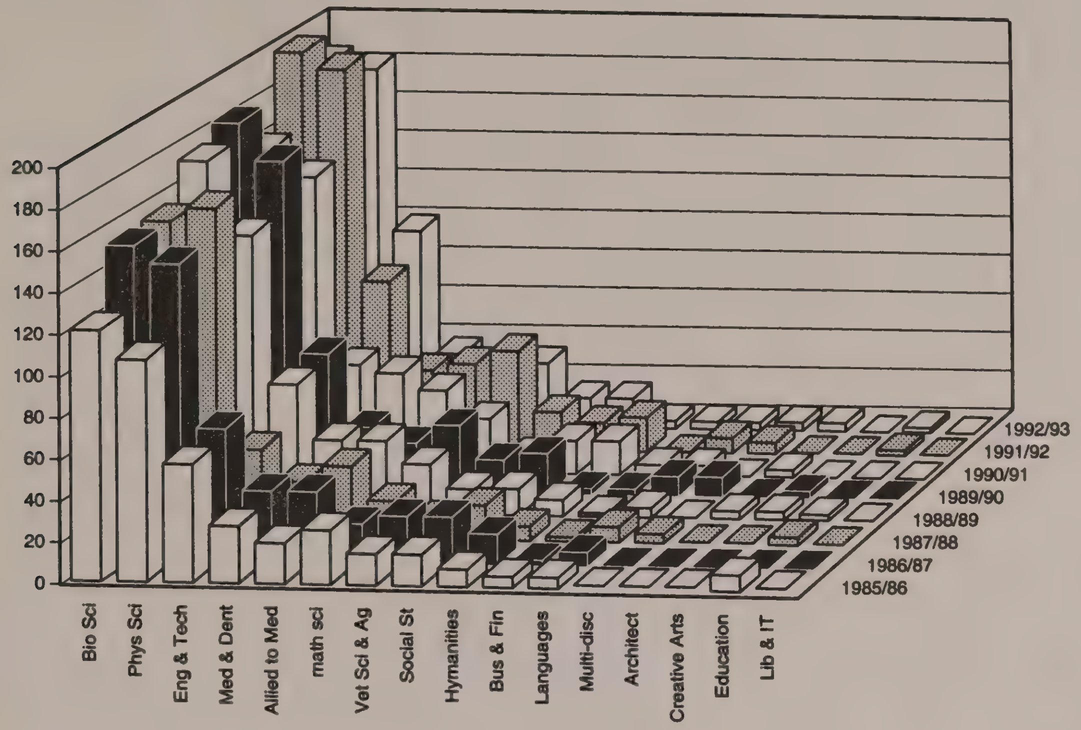
9.11 First Degree Graduates entering scientific and engineering research, design & development



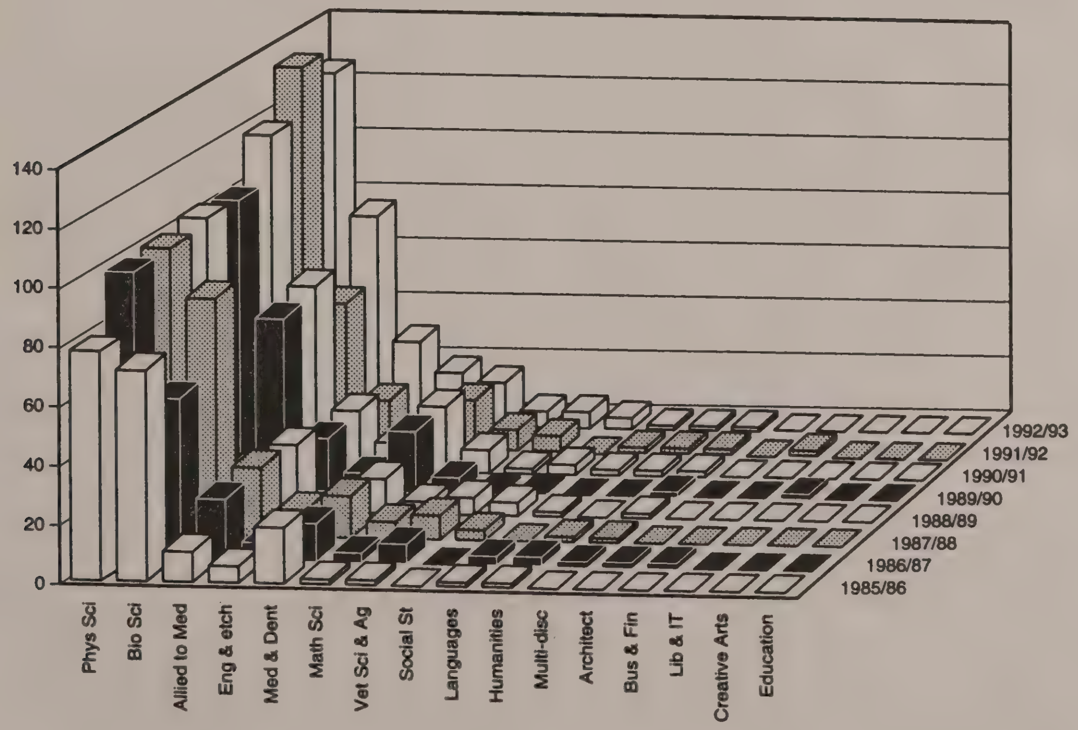
9.12 Higher Degree Graduates entering scientific and engineering research, design & development



9.13 Post Doctoral Fellowships - Home



9.14 Post Doctoral Fellowships - Overseas



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